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Cylvick

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(54) **INTEGRATED BOLLARD, ANCHOR, AND TOWER (IBAT) APPARATUS AND METHOD**

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B61B 7/02 (2006.01)
B61B 7/00 (2006.01)
B61B 7/04 (2006.01)
B61B 7/06 (2006.01)

(52) **U.S. Cl.**

CPC ***B61B 12/007*** (2013.01); ***B61B 7/00*** (2013.01); ***B61B 7/02*** (2013.01); ***B61B 7/04*** (2013.01); ***B61B 7/045*** (2013.01); ***B61B 7/06*** (2013.01)

(58) **Field of Classification Search**

CPC B61B 7/00; B61B 7/02; B61B 7/04; B61B 7/045; B61B 7/06; B61B 12/007
See application file for complete search history.

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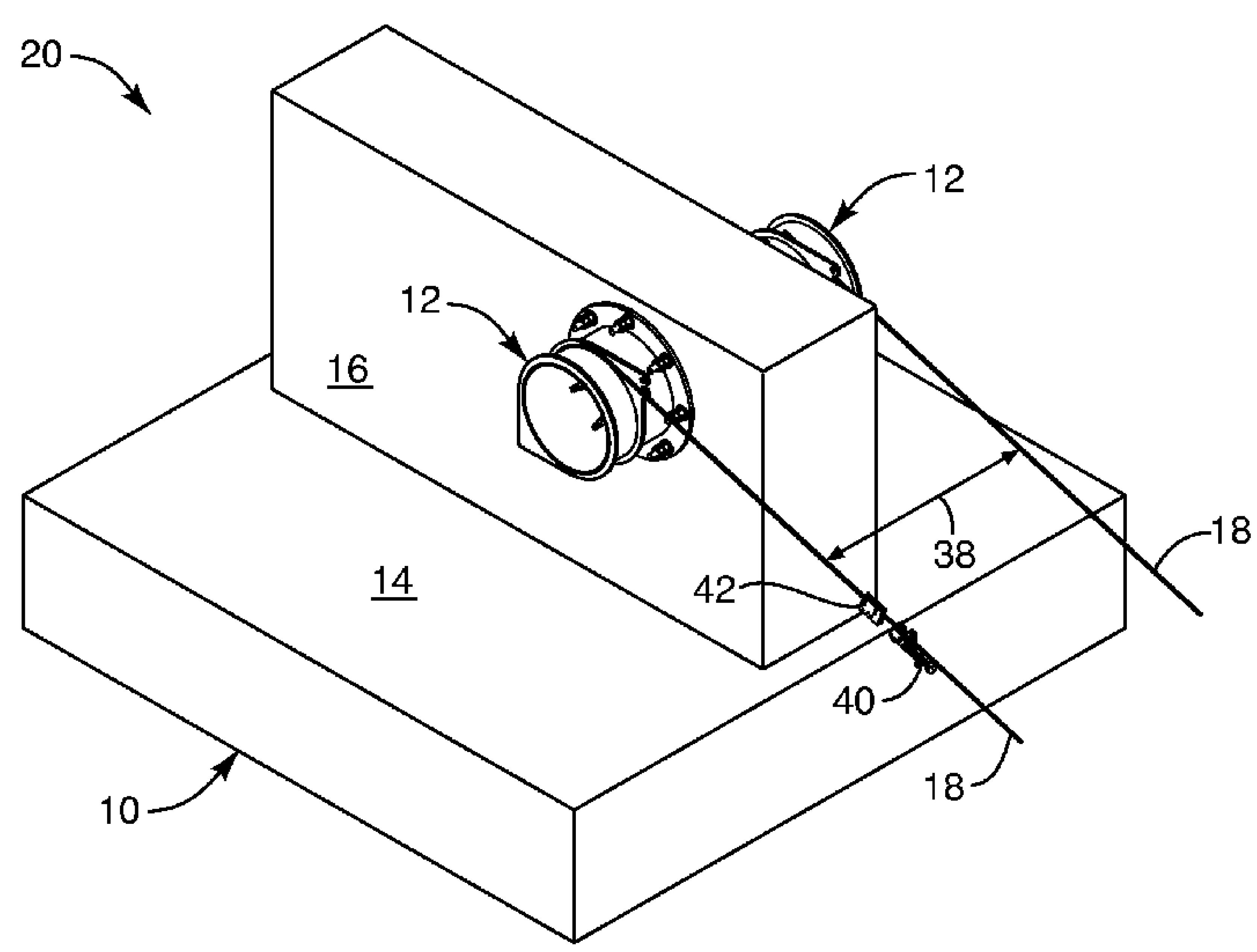
(57) **ABSTRACT**

An integrated bollard, anchor, and tower (IBAT) system constructed as a single monolith may be formed of a single material, such as concrete or steel, or assembled from components of distinct materials, such as reinforced concrete with metal brackets, fixtures, fasteners, and so forth. An anchor (e.g., base, pad), sized to engage the ground therebelow by weight and friction, includes a mass sufficient to provide frictional stability (no appreciable movement) of the IBAT unit at each end of a track line (cable, wire rope, line, etc.), which wraps around the bollard portion of each upright (tower, fin) portion at an operational height defining the path of a trolley carried on the free span of the resulting catenary.

20 Claims, 9 Drawing Sheets



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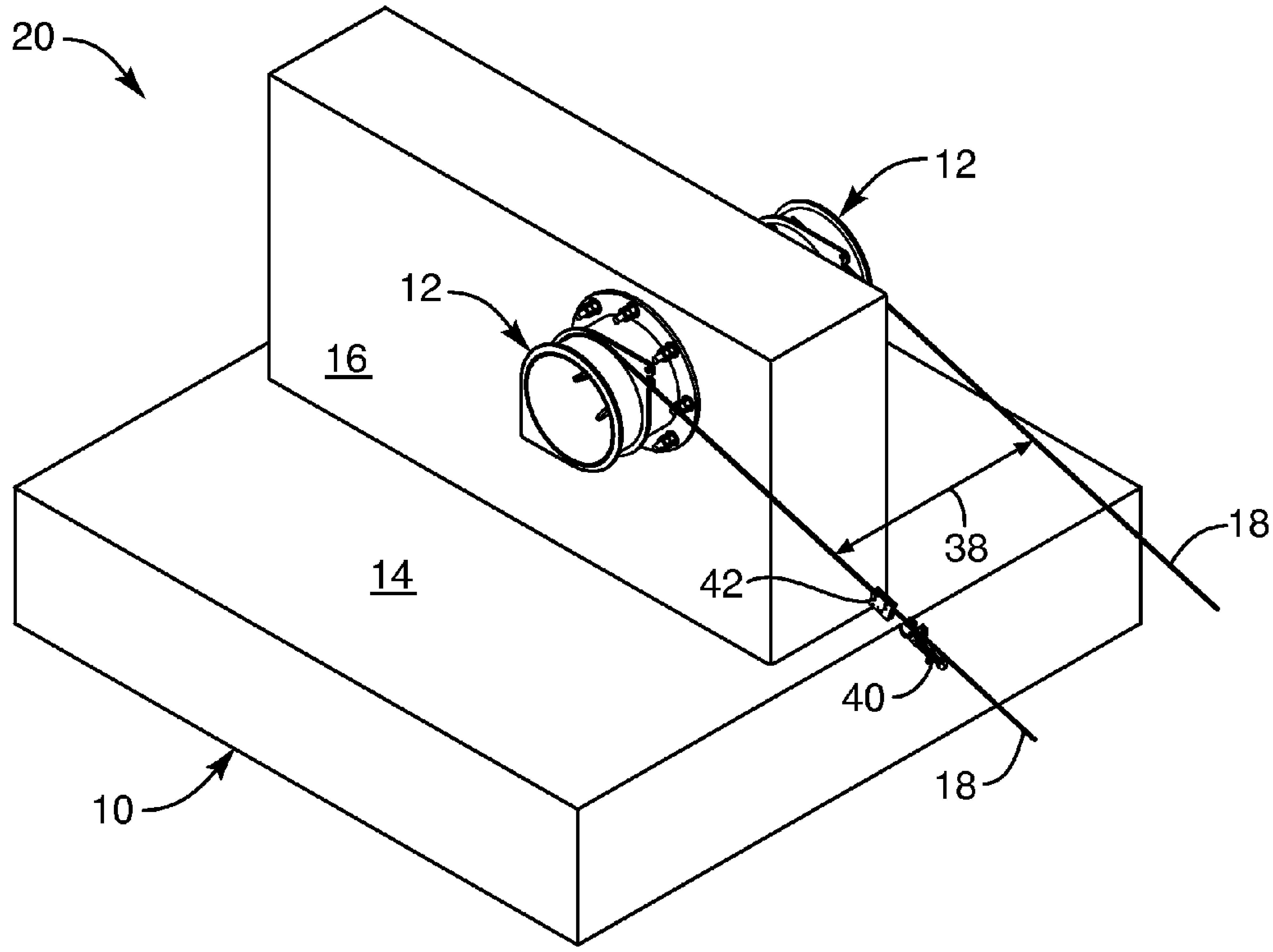
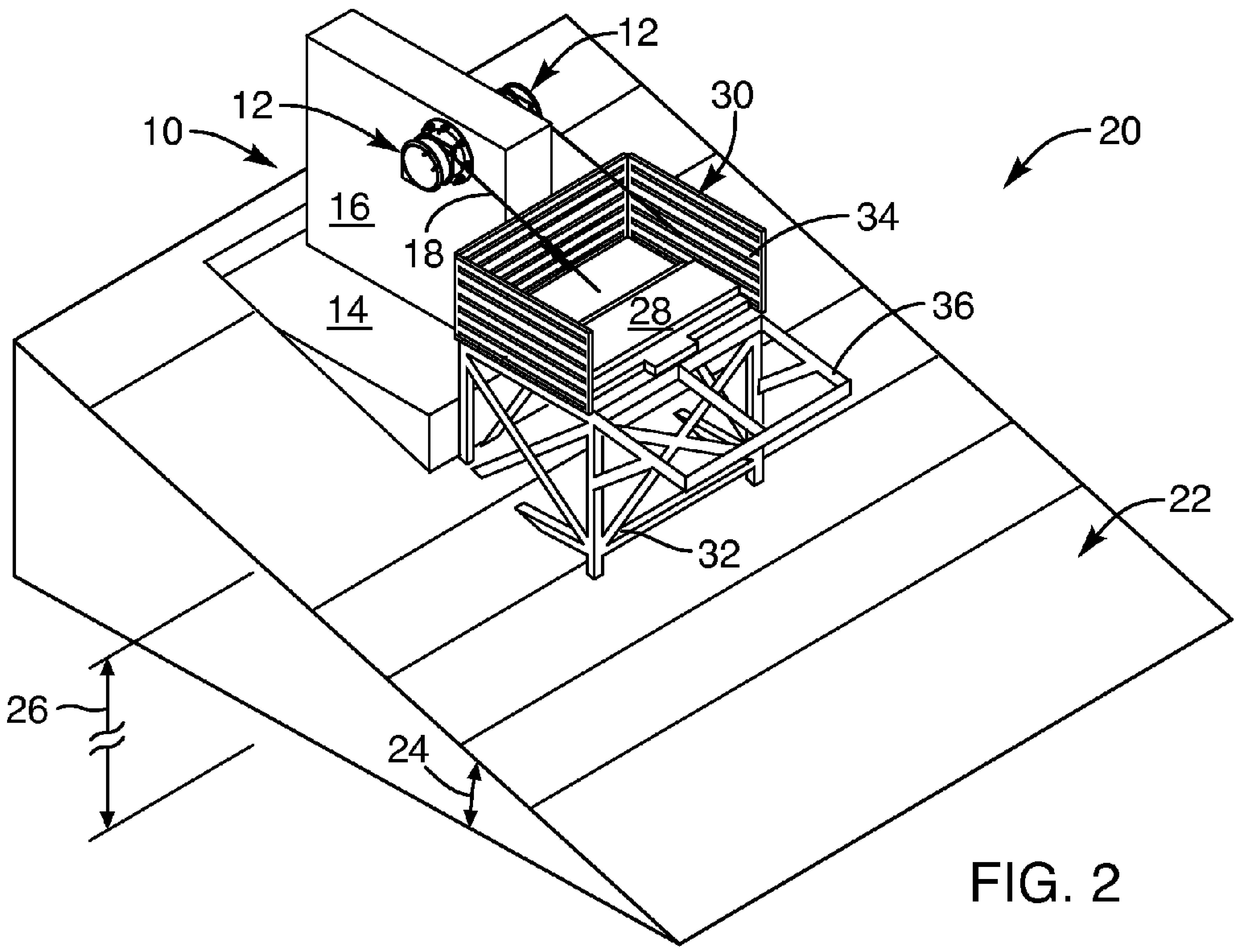

20
12
12
16
14
38
18
42
40
10
18

FIG. 1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12
30
10
20
16
34
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14
28
36
22
32
26
24

FIG. 2

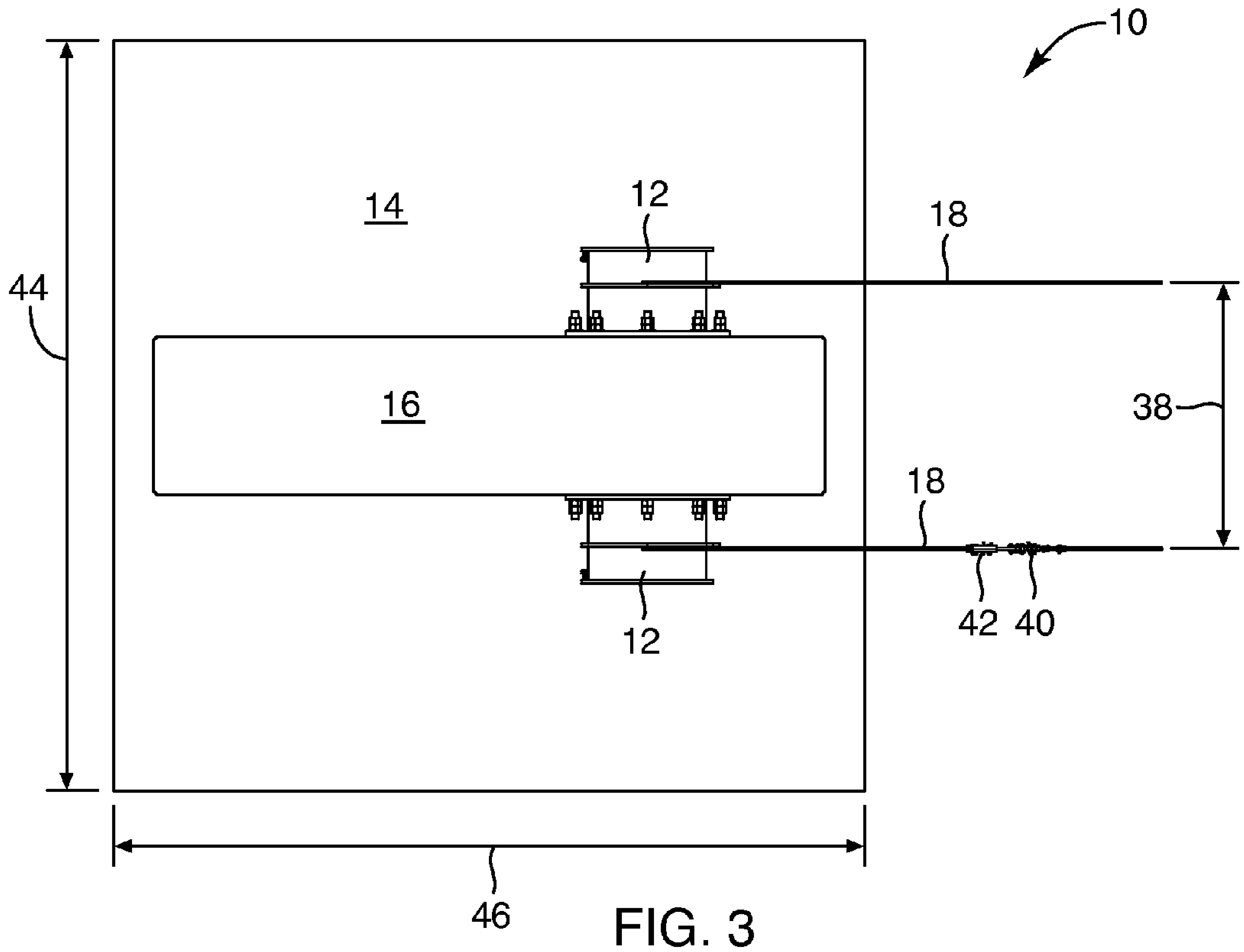

10
14
12
18
44
16
38
18
42
40
12
46

FIG. 3

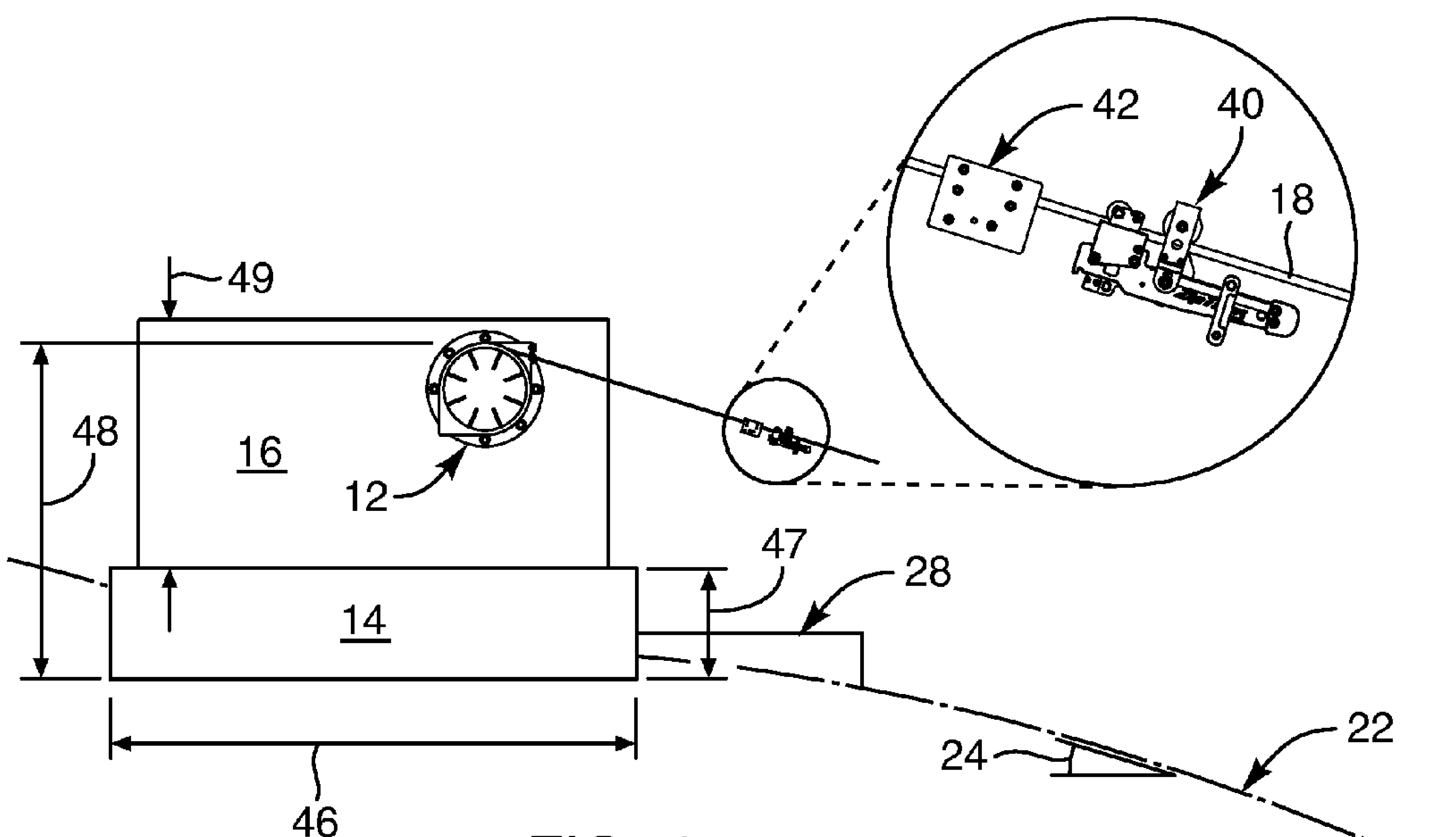

42
40
18
49
48
16
12
47
28
14
24
22
46

FIG. 4

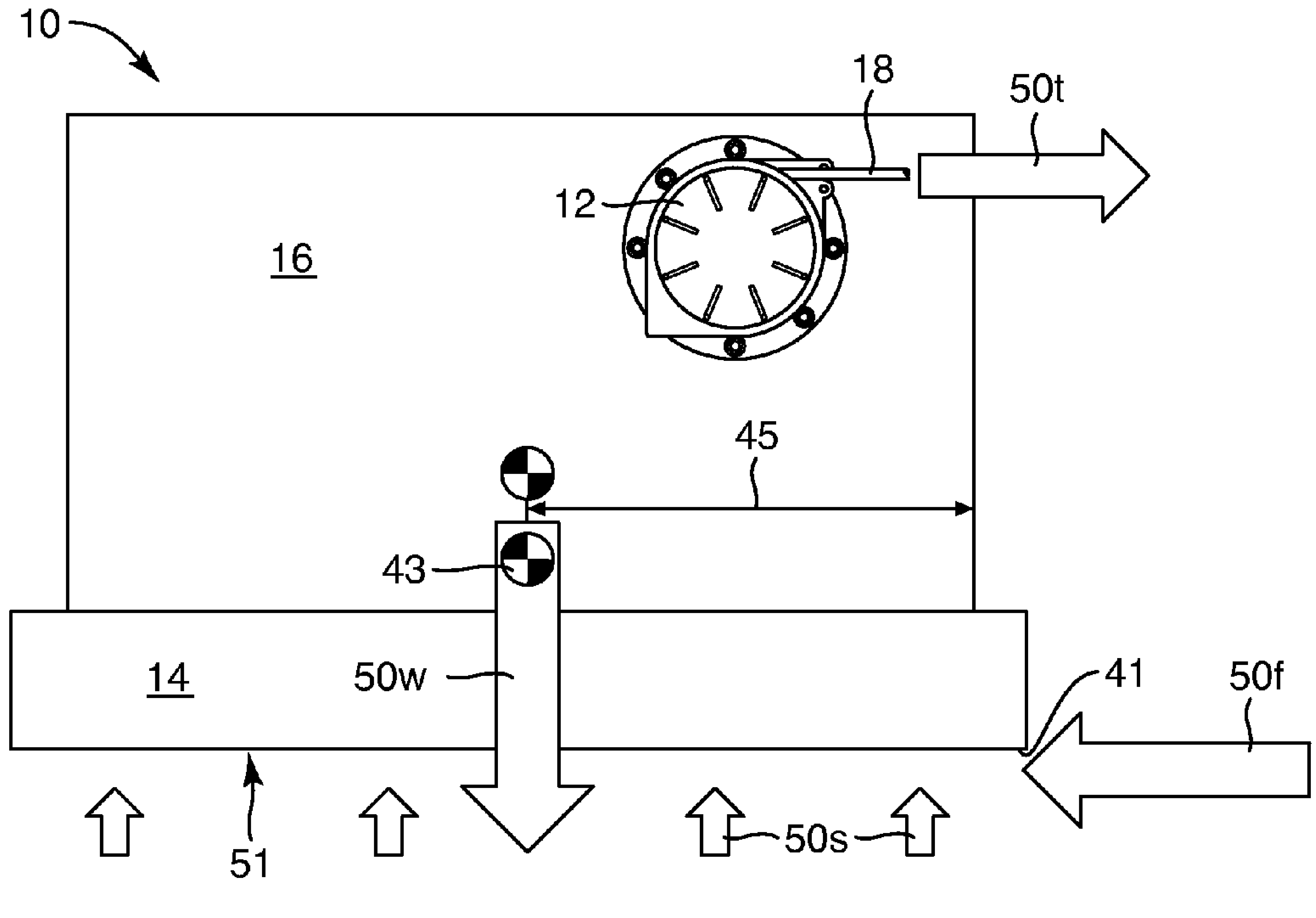

10
18
50t
12
16
45
43
14
50w
41
50f
51
50s

FIG. 5

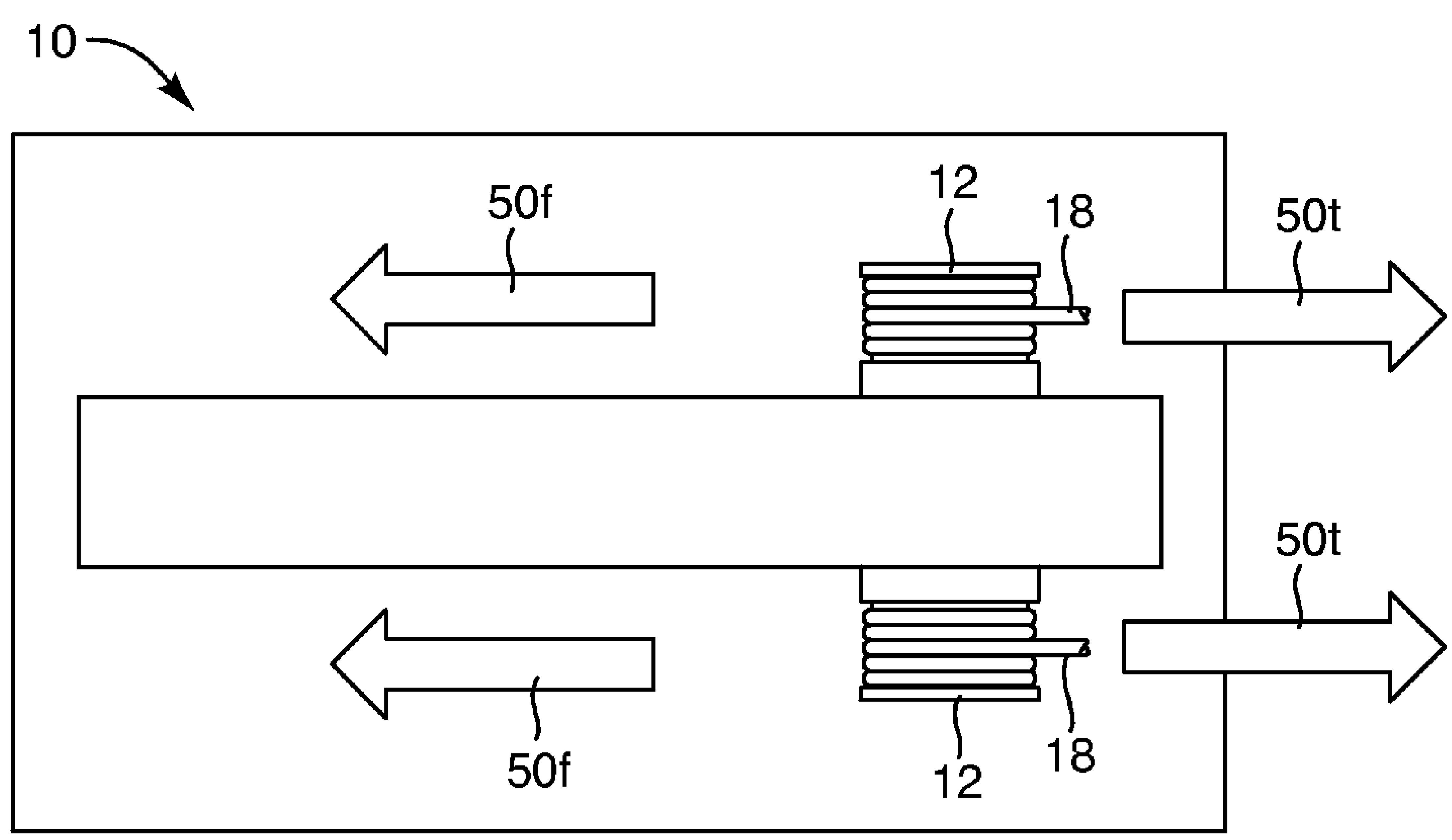

10
12
18
50f
50t
50t
50f
12
18

FIG. 6

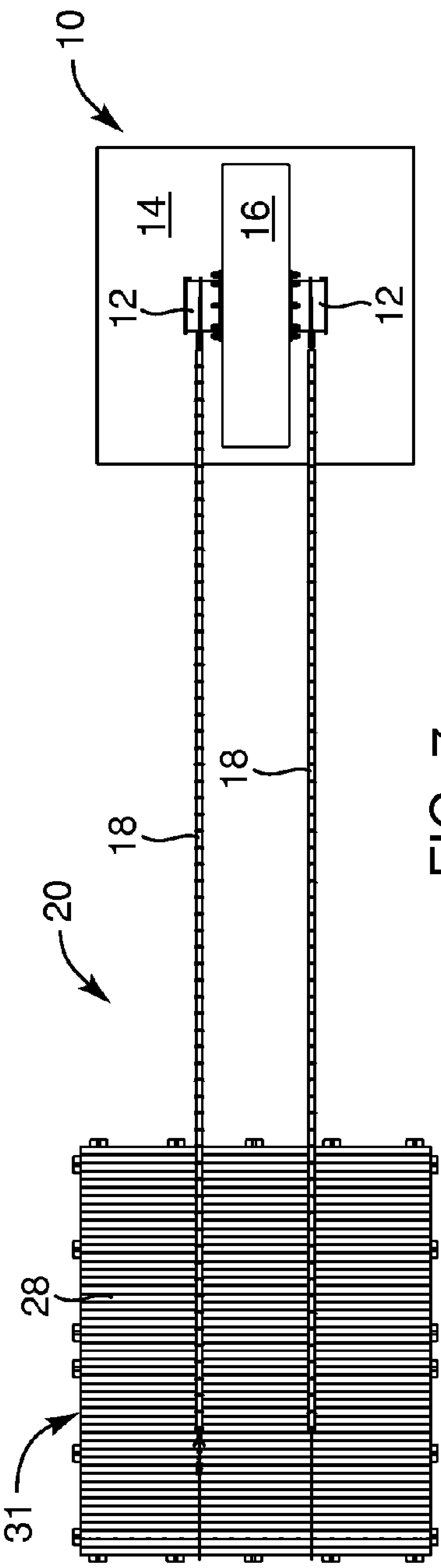


FIG. 7

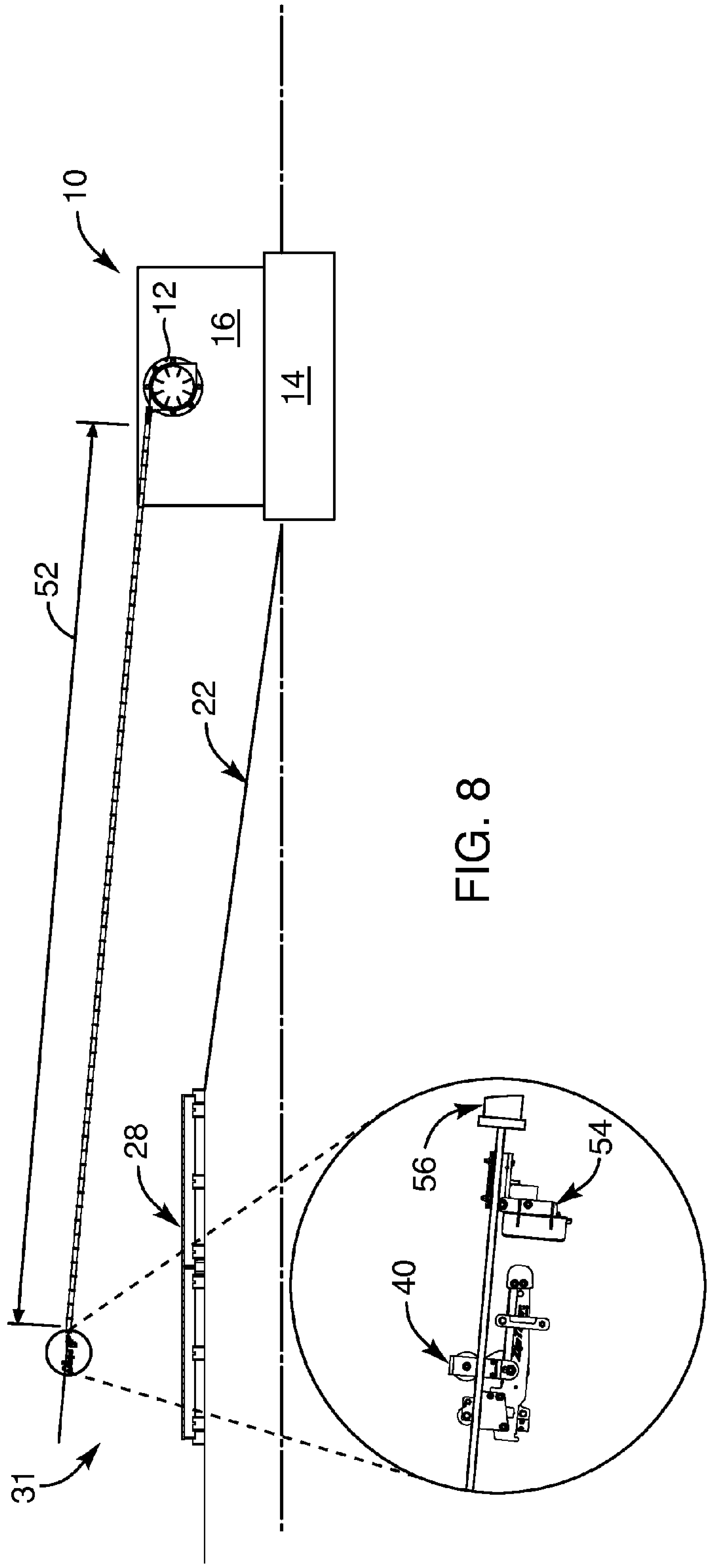


FIG. 8

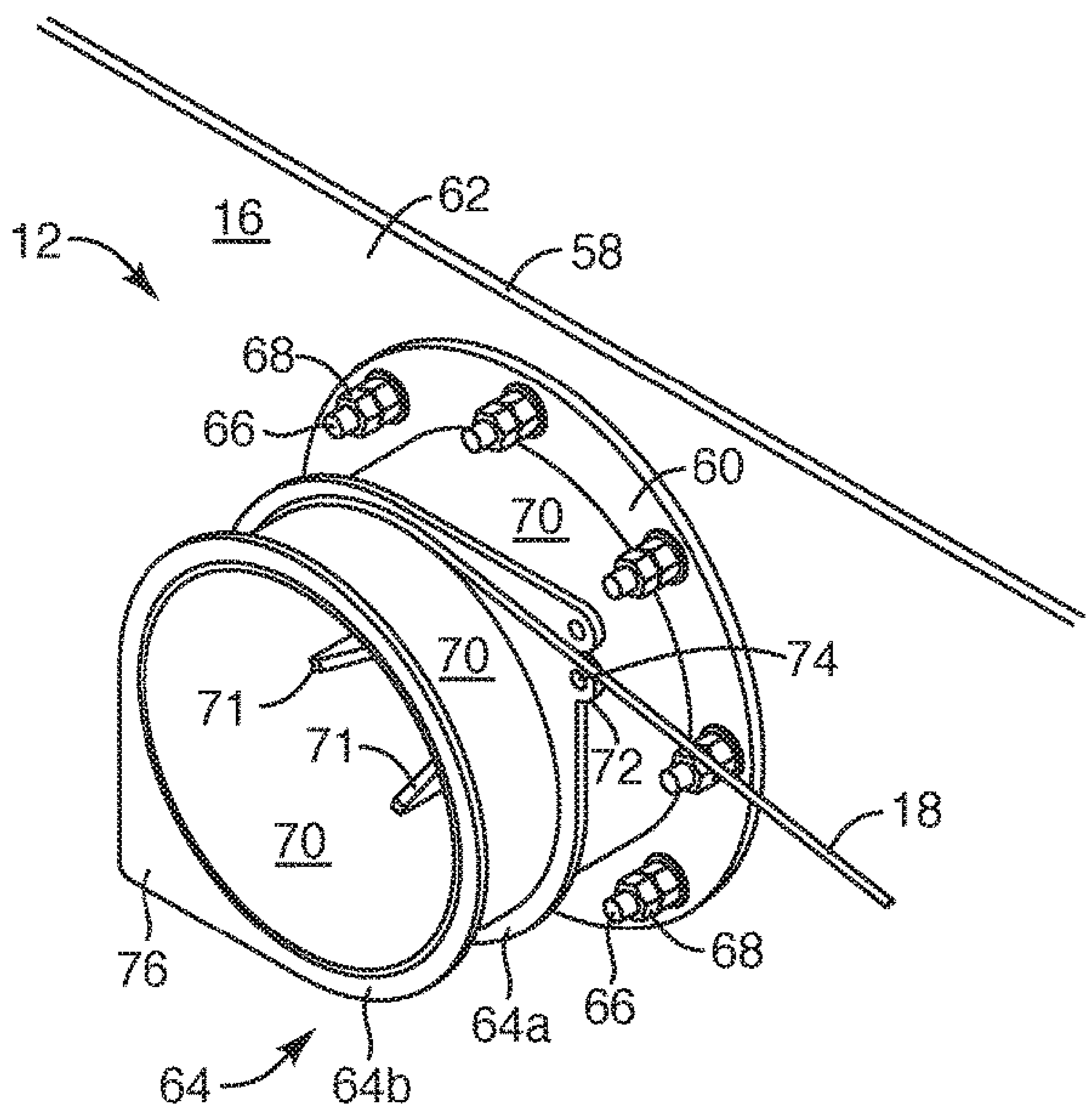
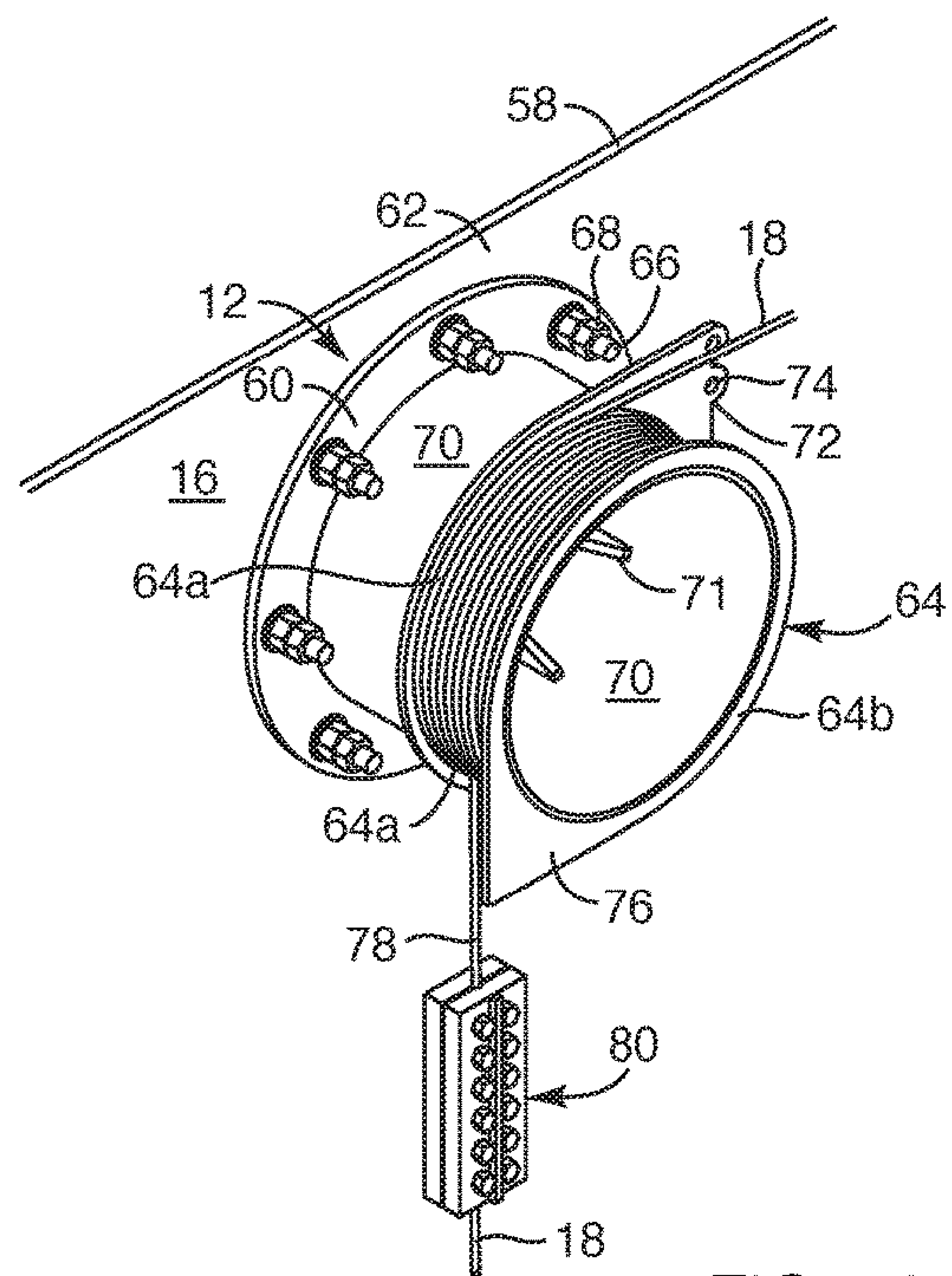

12
16
62
58
68
66
70
60
70
74
71
71
72
18
70
76
68
66
64a
64
64b

FIG. 9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62
68
66
18
12
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16
64a
71
64
70
64b
64a
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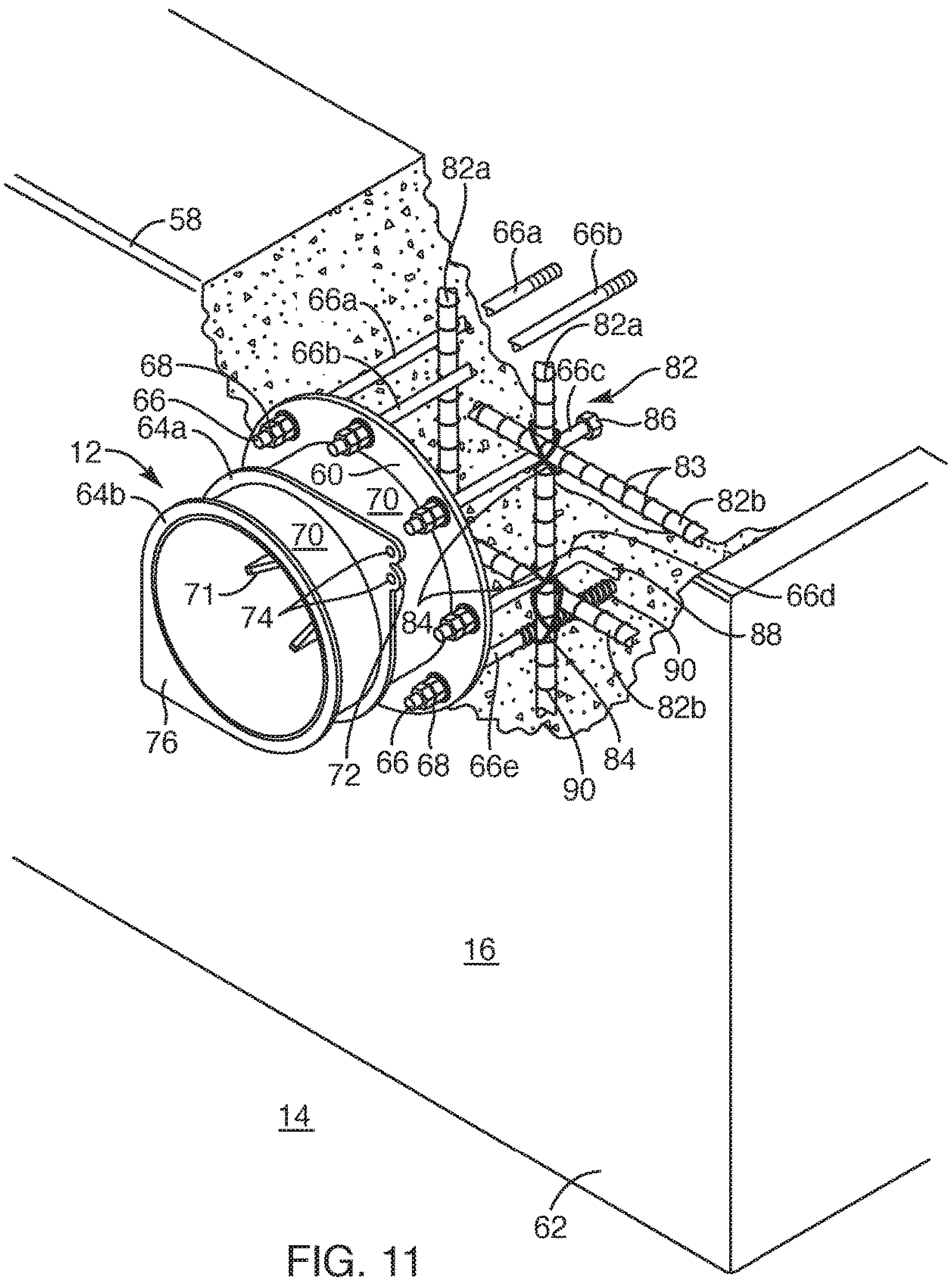
78
80
18

FIG. 10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82a
66b
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66c
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82b
64b
70
66d
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66
68
66e
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72
90
16
14
62

FIG. 11

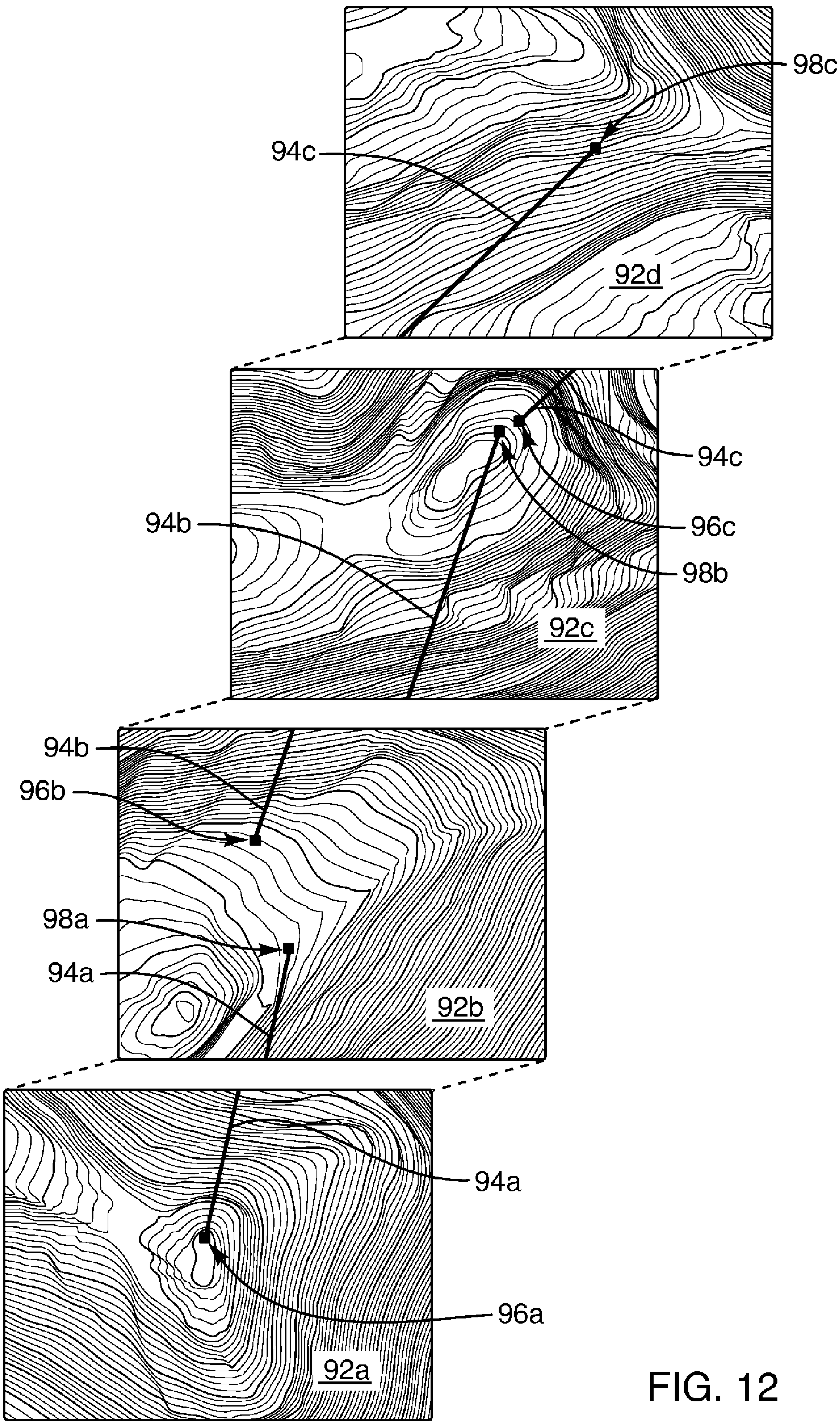

FIG. 12

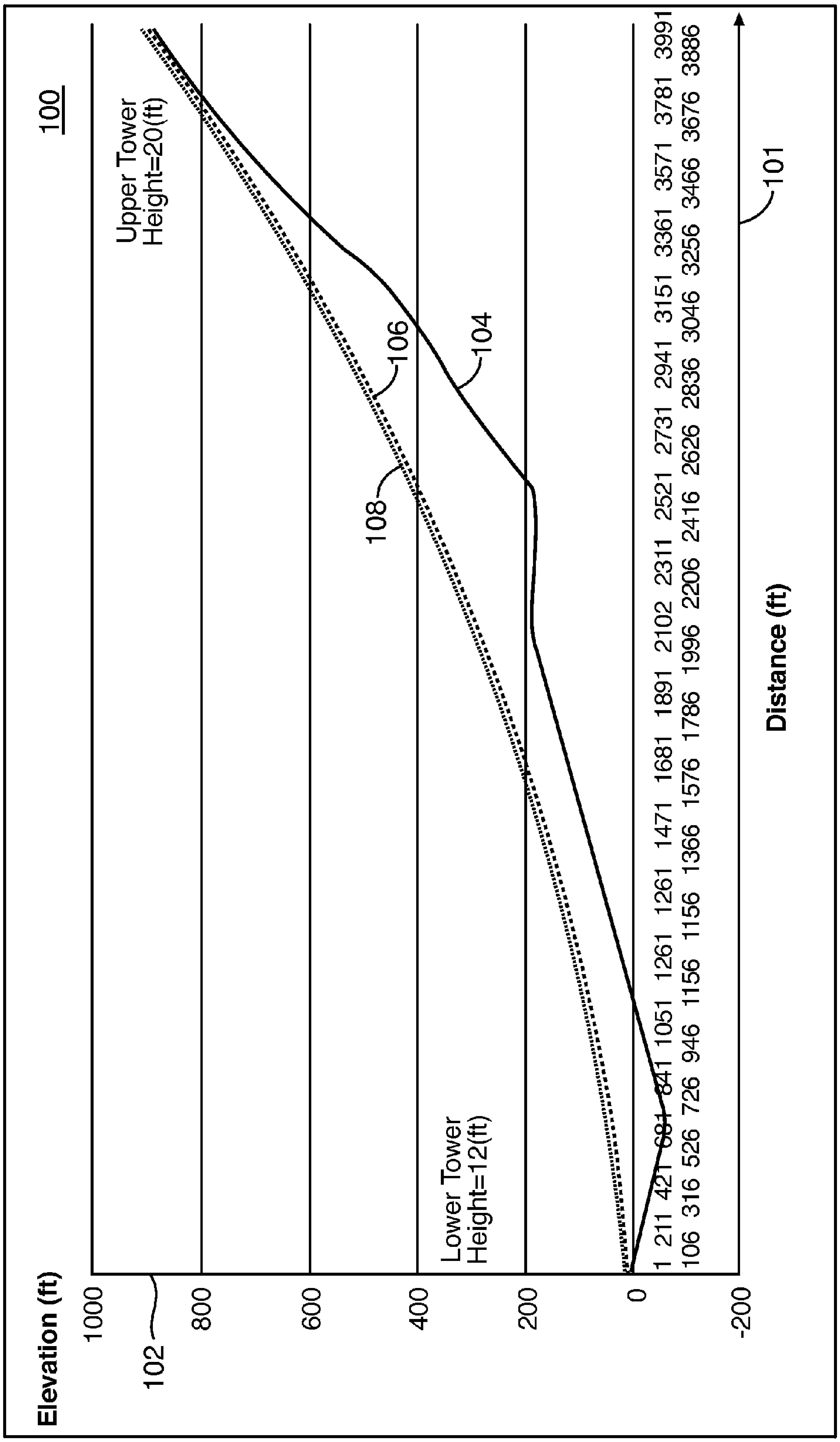
100
Elevation (ft)
1000
800
600
400
200
0
-200
102
Lower Tower
Height=12(ft)
Upper Tower
Height=20(ft)
106
104
108
101
1 211 421 631 841 1051 1261 1261 1471 1681 1891 2102 2311 2521 2731 2941 3151 3361 3571 3781 3991
106 316 526 726 946 1156 1156 1366 1576 1786 1996 2206 2416 2626 2836 3046 3256 3466 3676 3886
Distance (ft)

FIG. 13

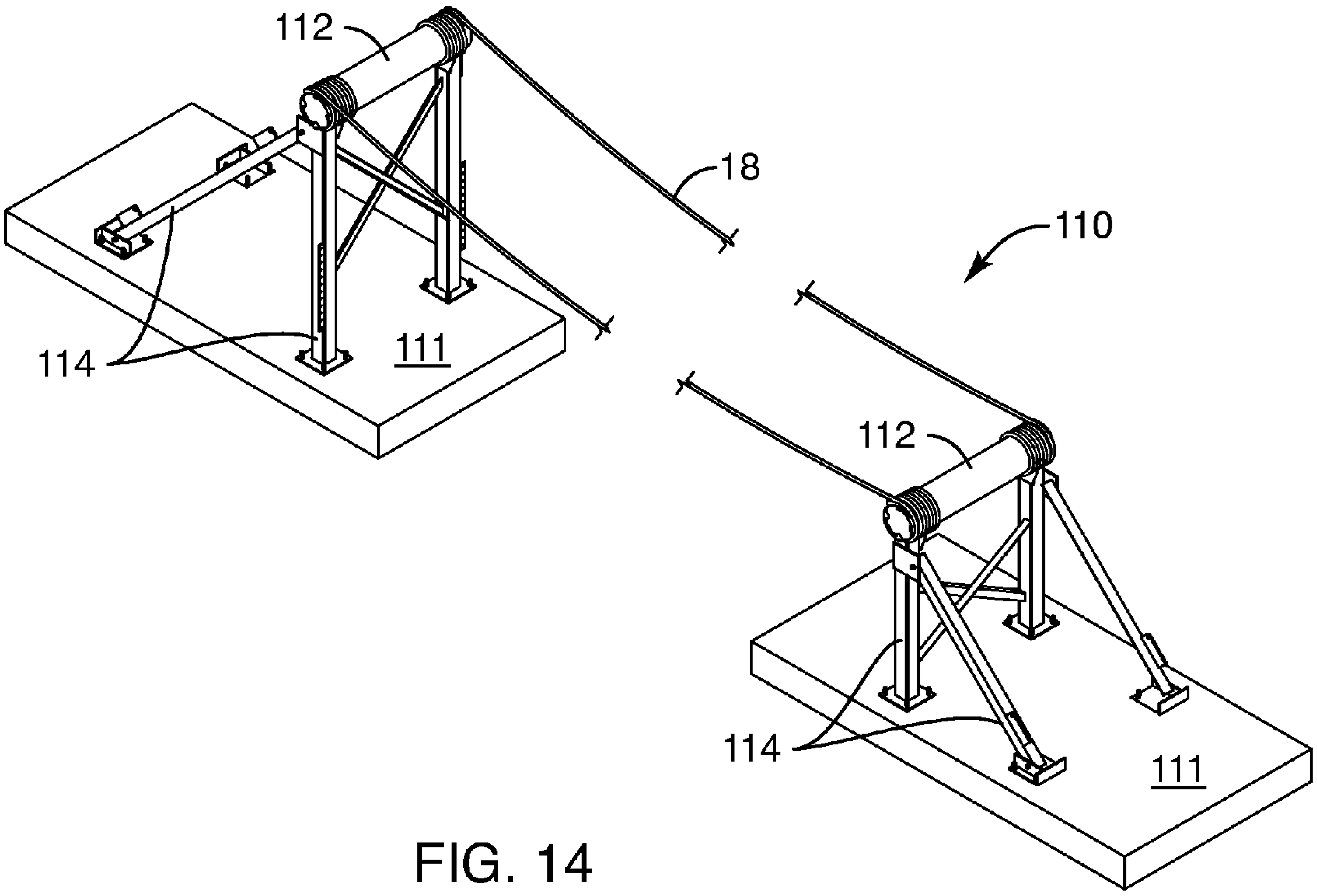

FIG. 14

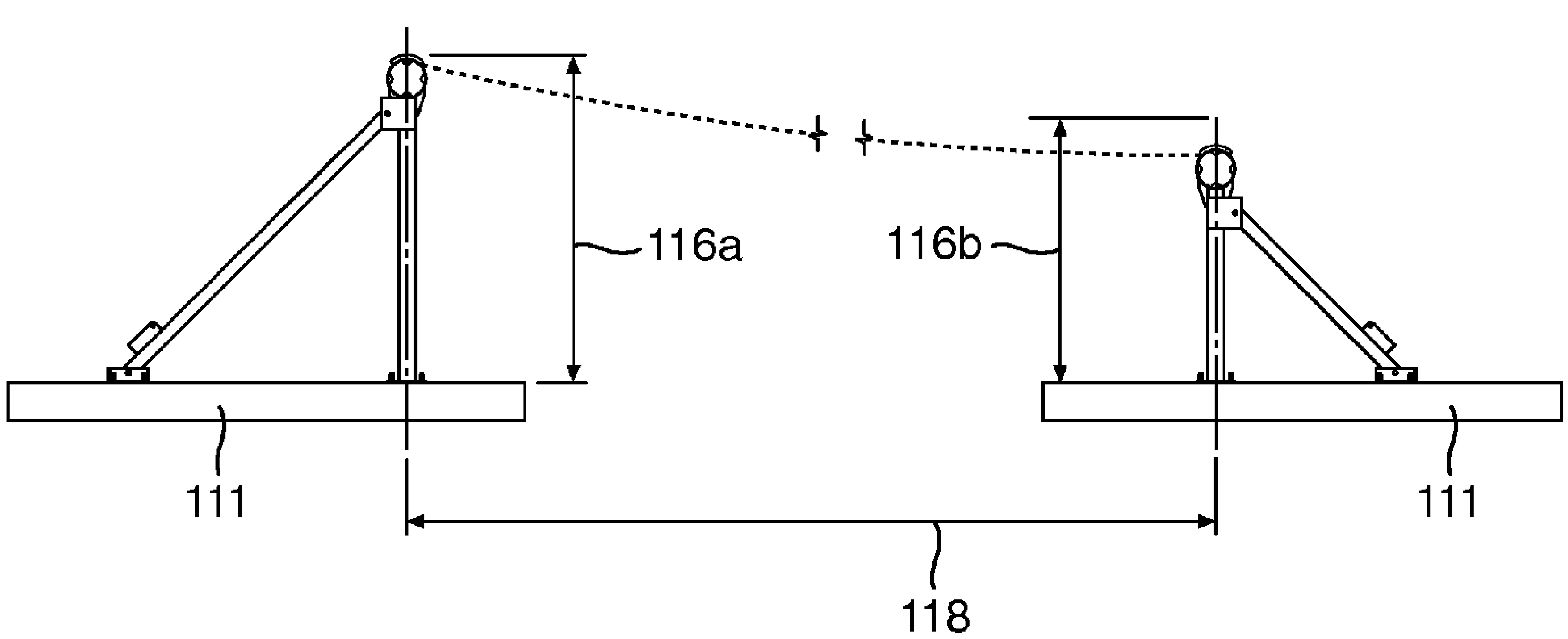

FIG. 15

INTEGRATED BOLLARD, ANCHOR, AND TOWER (IBAT) APPARATUS AND METHOD

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 62/058,544 filed Oct. 1, 2014, entitled INTEGRATED TOWER, BOLLARD, AND ANCHOR APPARATUS AND METHOD, which is hereby incorporated by reference in its entirety. This application also hereby incorporates by reference: U.S. Pat. No. 7,637,213, issued Dec. 29, 2009; U.S. Pat. No. 7,966,940, issued Jun. 28, 2011; U.S. Pat. No. 7,299,752, issued Nov. 27, 2007; U.S. Pat. No. 7,404,360, issued Jul. 29, 2008; U.S. Pat. No. 6,622,634, issued Sep. 23, 2003; U.S. Pat. No. 6,666,773, issued Dec. 23, 2003; U.S. Pat. No. 8,191,482, issued Jun. 5, 2012; U.S. Pat. No. 8,333,155, issued Dec. 18, 2012; and U.S. patent application Ser. No. 14/451,932, filed Aug. 5, 2014.

BACKGROUND

1. Field of the Invention

This invention relates to trams for carrying vehicles such as gondolas, chairs, and harnesses on trollies rolling along track lines, and, more specifically to bollard, anchoring, and tower systems for supporting track lines.

2. Background Art

Trams may have a moving line that supports and drives lift chairs, as in ski lifts. They may instead ride on a stationary track line suspended over towers installed between anchors at each end. The track line may suspend freely as a catenary or pass over intermediate towers. The track line may support the weight, while a haul line connected to the vehicle (tram, car, seat, gondola, trolley, or other carrier of people, articles, or materials) actually controls speed and provides the motive force to move the vehicle. It would be an advance in the art to create an end-of-line, anchoring system, for securing each end of a track line, while presenting a reduced profile imposing on the surrounding environment. This is particularly true for a zip line installation, such as a multiple-leg system of lines in a remote or scenic "tour" installation.

SUMMARY OF THE INVENTION

A trolley travels on a track line between two units that each constitutes a unitary, integrated, bollard, anchor, and tower (IBAT) system in a single monolith. The monolith may be formed of a single material, such as concrete or steel. It may also be assembled from components of distinct materials.

However, in one embodiment of an apparatus and method in accordance with the invention, the system includes an anchor portion sized to provide engagement with the ground below and having a mass and weight sufficient to provide frictional stability, meaning no appreciable movement of the integrated tower-bollard-anchor unit at each end. Meanwhile, the track line is wrapped around the bollard portion, extending from the tower portion at a proper height for operation. The tower portion extends upward from the anchor portion on the underlying surface of the ground supporting it.

The track line extends from the bollard on the top unit to the bollard on the bottom unit. Typically, the track line is a catenary in a free span between the upper bollard and lower bollard. The tower is a concrete fin extending up from a

concrete foundation or pad. The pad is sized in horizontal area and vertical thickness to have a mass suitable to render the unit immovable against all loads contemplated to be exerted on the unit by the track line in use.

The tower may be poured with the pad, or may be poured on the pad, with suitable rebar connections. Also, the bollard may be poured with the fin or may be secured to bolts secured into the concrete of the fin-like tower. The anchor (pad), tower (fin), and bollard are all fixed with respect to one another in an integrated termination of the ride, where the ride constitutes an upper unit, lower unit, track line, and a trolley for carrying a load, such as a zip line passenger.

In one embodiment, a tower system as an integrated, monolithic, multi-functional apparatus comprising a first base portion operating as an anchor having a mass and a surface area selected to render the first base portion effectively immovable with respect to ground therebelow, the surface area being in contact with the ground. A first tower portion may be integral and substantially homogenously formed with the first base portion to be monolithic therewith, the first tower portion extending upward away from the base portion a preselected distance vertically, defining thereby an operational height above the ground for a track line.

A first bollard portion may extend rigidly from the tower portion and be shaped to reduce stress in a track line wrapped therearound and loaded in tension. The track line may be wrapped around the bollard portion to extend in a longitudinal direction away therefrom. The bollard and the track line may both be considered to be supporting a load in tension. That load (force, stress) may be engineered and selected with the mass (and therefore weight), and surface area of the first base portion to support the load by frictional engagement of the anchor (base) while maintaining the tower system substantially immovable.

The IBAT system or tower system may include a trolley supported by the line or track line to travel in at least one of the directions away from and toward the tower portion along the track line. A second tower portion substantially homogeneously formed with a second base portion and supporting a second bollard portion extending therefrom supports the track line from an opposite end of the line. The line is wrapped around the bollard to reduce stress in the line, provide frictional engagement therebetween, and limit the bend radius of the line (e.g., wire rope).

The bulk of the first base portion and first tower portion may be formed in one or more pours of concrete, reinforced by re-bar or pre-stressed rods or cables therein. The first base portion and first tower portion may both include steel re-bar, which may be contiguous, continuous, connected, interlocking or otherwise tying the tower to the anchor (base) in a reinforcing the concrete.

The bollards may be cast in concrete also. Alternatively, the bollards may be metal structures secured by various fasteners securing the first bollard portion to the first tower portion. A second bollard or bollard portion may be opposite the first. One reason to speak of the bollard, anchor, and tower as bollard portion, anchor portion, and tower portion is because they are all fixed together to become an integrated, rigid body. That rigid body may be formed of a single material, a single construction, or assembled components.

Bollards typically include at least one of concrete, steel, reinforced concrete, and a reinforced polymeric material. Usually, they include at least two. If the bollard portion is formed substantially homogeneously with the first tower portion, it may be done as a single material, but typically as a reinforced material. For example, the first base portion and first tower portion are each comprised principally of concrete, but reinforced by steel extending contiguously therebetween. Thus, they are not strictly homogeneous, as made of a single material, but are homogeneous in that each is made of the same structural materials distributed in the same way as "reinforced concrete," for example.

A first deck (launch platform) is positioned lower than the first bollard portion, sized and spaced from the bollard portion and track line to receive and launch a rider from the first deck. A second IBAT is placed below, beyond a lower "landing deck" or landing platform.

A method of construction may include providing a tower system comprising a first base portion having a mass and a surface area selected to render the first base portion effectively immovable with respect to a supporting surface therebelow, a first tower portion, integral with the first base portion to be monolithic therewith and extending away therefrom a distance vertically to define an operational height above the supporting, and a first bollard portion, extending rigidly and orthogonally from the first tower portion. To this is provided a track line, having a first end portion wrapped around the first bollard portion to be supported thereby and extending away therefrom.

Thereupon, a trolley, riding on the track line supports a load by tensioning the track line. The distance is selected, and the shape of the surface area is selected to prevent tipping of the tower portion and base in response to the tensioning.

The use includes loading a rider on the trolley at the deck, releasing the trolley to traverse the track line extending as a catenary extending freely between the first and second bollard portions, and eventually braking the user to a halt with a spring system for braking and for rebound or recoil attenuation. Then, one may, either as an operator or a rider, unload the rider from the trolley proximate the second tower portion, on the lower landing deck. Optionally, one may detach the trolley from the track line and carry it to another subsequent line, attach it thereto, and ride the span (line) to yet another terminus.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing features of the present invention will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only typical embodiments of the invention and are, therefore, not to be considered limiting of its scope, the invention will be described with additional specificity and detail through use of the accompanying drawings in which:

FIG. **1** is a perspective view of one embodiment of an integrated bollard, anchor, and tower (IBAT) system in accordance with the invention;

FIG. **2** is a perspective view of one embodiment thereof showing underlying terrain and a launch platform;

FIG. **3** is a top plan view of one embodiment of an integrated bollard, anchor, and tower (IBAT) system in accordance with the invention;

FIG. **4** is a side elevation view thereof illustrating surrounding terrain;

FIG. **5** is a side elevation view of a force schematic diagram illustrating the significant forces operating on an IBAT system in accordance with the invention;

FIG. **6** is a top, plan, schematic view thereof;

FIG. **7** is a top plan view of one embodiment of a lower terminus for an IBAT system in accordance with the invention;

FIG. **8** is a side elevation view thereof;

FIG. **9** is a frontal perspective view of one embodiment of a bollard in accordance with the invention;

FIG. **10** is a rear perspective view thereof, illustrating the cable securement and track line (wire rope or cable);

FIG. **11** is a frontal, perspective, cutaway view of a tower portion illustrating a bollard and reinforcement bar installation in accordance with the invention;

FIG. **12** is an IBAT layout on terrain in accordance with the invention;

FIG. **13** is a chart illustrating relative elevations in one example of a span of an IBAT system installation on available terrain;

FIG. **14** is a perspective view of one embodiment of a practice tower and line system; and

FIG. **15** is a side elevation view thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It will be readily understood that the components of the present invention, as generally described and illustrated in the drawings herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the system and method of the present invention, as represented in the drawings, is not intended to limit the scope of the invention, as claimed, but is merely representative of various embodiments of the invention. The illustrated embodiments of the invention will be best understood by reference to the drawings, wherein like parts are designated by like numerals throughout.

Referring to FIG. **1**, an integrated bollard, anchor, and tower system (IBAT) **10** will include at least one bollard **12**, and conceivably more. For example, in the illustrated embodiment, two bollards **12** are one on each side of a tower portion **16** supported on a base portion **14** or anchor portion **14**. The bollards **12** flank the tower portion **16** or tower **16** symmetrically.

In the illustrated embodiment, the entire base **14** or anchor **14** and tower **16** may be formed as a single integrated component. All may be manufactured or constructed in a single pour of concrete, for example. In other embodiments, the base **14** and tower **16** may be formed in different pours, but still at a single location, such as an on-site construction.

Conceivably, the base **14** and tower **16** may be separately poured and assembled. However, several benefits may be lost thereby. For example, concrete trucks may deliver loads of concrete in steep terrain at high elevations. Obtaining stable placement for cranes is substantially more difficult. Moreover, large cranes at remote locations create many more problems than several yards of concrete in the back of a concrete mixer truck, as part of a multiple-load pour.

Referring to FIGS. **1** through **4**, while also referring generally to FIGS. **1** through **15**, an IBAT system **10** secures a line **18** and typically multiple lines **18**. It is conceivable that the bollards **12** may extend different distances, exist at different levels (altitudes), or both. However, in the illustrated embodiments, a comparatively short distance between the bollards **12** through a tower portion **16** need only accommodate two riders and protect them against collision.

In contrast, putting other bollards **12** extending greater distances and thus including more lines **18** increases the possibility of angular rotation (yaw), loading, and so forth. One of the beauties of a system **10** in accordance with the invention is that a comparatively insignificant turning moment (as that term is used in engineering parlance, meaning a force operating at a distance, and thus creating leverage) is of very little or no consequence. Any additional length for a bollard **12** to extend away from the tower portion **16** necessarily increases the leverage, and thus the turning moment that might be exerted by a line **18** against the tower **16** and base **14** integrated with it.

Typically, the IBAT system **10** may be used in a cable ride **20**, amusement ride **20**, or simply a ride **20**, such as a zipline, a "canopy tour," or the like. Necessarily, the IBAT system **10** must accommodate various terrain **22**. Typically, the terrain **22** will have a slope **24** that varies with distance in all dimensions.

Along the surface **22** of the earth, the slope **24** may vary radically within comparatively short distances on the order of a few feet or meters. Similarly, in a distance of feet or meters to miles or kilometers, elevation may rise either gently or precipitously several times, and drop similarly. Thus, the elevation **26** at which a base **14** is installed as an anchor **14** will necessarily influence the vertical clearance required, and thus the altitude of the bollard **12** above the base elevation **26**. Lateral clearance orthogonal thereto must also be engineered into a ride **20**. Thus, analysis of elevation change, generally, must consider the undulation or rising and falling of the surface **22** or terrain **22** between upper and lower systems **10**.

One benefit of an IBAT system **10** in accordance with the invention is the reduced profile, while still including sufficient clearance of a rider above the underlying terrain **22**. For example, a base or anchor portion **14** and tower portion **16** may include thousands of pounds of weight. Unlike conventional towers used in trams, ski lifts, ziplines, and so forth, the tower **16** contributes a substantial fraction of anchoring weight, yet no high (30 feet or more) of altitude is required for the tower portion **16**. Typically, from the base elevation **26** to the top of the bollard **12** or the top of the tower **16** may need only be from about 12 to about 20 feet. Greater distances are permissible. Lesser distances are permissible. However, this range has been found suitable. It provides for the height of users, the proximity of overhead lines **18** or track lines **18**, and the clearance necessary between the feet of a user riding the line **18**, and any collision or surface of the underlying terrain **22**.

In certain embodiments, a deck **28** or platform **28** may serve as the central element of a launch station **30** near an upper reach or upper end of a line **18** or track line **18**. The deck **28** may or may not require any underlying structure **32** as a support structure **32**. Typically, a barrier **34**, such as a railing **34**, fence **34**, or the like may surround the deck **28** or the entire launch station **30** in order to provide safety against falls, interference with equipment, and other safety considerations.

Similarly, a net frame **36** may support netting. Nets may also proceed or extend beyond the net frame **36**. However, a net frame **36** serves to protect anyone who should fall from the platform **28** or deck **28** during loading, or immediately after launch. For example, a faulty harness, an accidental release, horseplay, inexperience, lack of care, or the like might lead to a fall, which may be rendered harmless by a suitable net secured by a net frame **36**.

In the illustrated embodiment, having a pair of bollards **12** secured to a single tower **16** in an IBAT system **10** provides the benefit of symmetry. For example, by setting a distance **38** between the lines **18** on adjacent bollards **12** fixed to a tower **16**, the loading by cables **18** or lines **18** is symmetric, thus removing any rotational moment in a horizontal plan or yaw component of force. Typically, the distance **38** is selected to be larger than the overall arm span (fingertip to fingertip) of the largest contemplated user. This assures that the adjacent riders will not collide with one another.

Another criterion for setting the spacing **39** or distance **38** between the lines **18** is the arc that a harness and rider would make in pivoting in a vertical plane normal (perpendicular) to the line **18**. Inasmuch as it is possible with a freely rolling trolley **40** on a line **18**, to swing circumferentially about the line **18** as an axis **18**, a distance **38** between the lines **18** should be set to preclude collision between riders.

Referring to FIGS. **1** through **4**, while continuing to refer generally to FIGS. **1** through **15**, a trolley **40** will typically carry a passenger, traveling along the line **18**. A passenger will typically enter into a seat or harness. An operator or the individual rider may operate a release. The release permits the trolley **40** and the rider suspended thereunder in the harness or seat (not shown) to travel downward under the effect of gravity along the suspended line **18**.

One practical reality ever present is safety. Accordingly, U.S. patent Ser. No. 14/451,932 filed Aug. 5, 2014 and entitled TERMINAL-RECOIL-ATTENUATION SYSTEM AND METHOD, incorporated hereinabove by reference, discloses a launch block **42**, in several embodiments for registering the trolley **40** at a launch station **30**. Typically, a user will stand on the launch platform **28** or deck **28** while harnessing, connecting, or both. However, in certain embodiments, for example, in the various types of trollies disclosed in the U.S. Patents incorporated hereinabove by reference, various trollies **40** with braking systems, and various types of control over speed, braking, or both illustrate how this may be done. Thus, there is no need to repeat here all the details of how the launch block **42** cooperates with a trolley **40** to register a rider and maintain safety and security thereof.

Thus, it is entirely within contemplation for an individual user to remain in harness while walking between various lines **18** or various spans **18**. A rider may simply walk to the starting point of one span from an ending point of another by removing a trolley **40** from the harness worn by the user, and removing the trolley **40** from the line **18**. Thus, a user may carry the trolley **40** to another span **18**, mount the platform **28**, and reconnect the trolley **40** to a new line **18**.

Thereupon, a user may connect to the trolley **40** by the harness and engage the new line **18** in another ride **20** along a different span across the underlying terrain **22**. In certain embodiments, a user need not unclip or disconnect from the trolley. A user may simply use the available slack to set the trolley on his or her shoulder, or in a pack, and amble on over to ride a new span.

The IBAT system **10** benefits from certain dimensions. One improvement for construction of ziplines is the elimination of the use of overhead lifts. For example, in remote locations, especially inaccessible, steep, mountainsides, helicopters, and cranes are expensive, dangerous, not completely satisfactory, yet often necessary to set up conventional towers for supporting track lines **18**.

In an apparatus and method in accordance with the invention, no crane is necessary. Access by trucks, tracked mountain tractors operating like snow cats, and the like can typically navigate along mountain trails, clearings, ski paths, and so forth. Concrete trucks can often navigate steep, winding, mountain roads or other passages. Thus, in one embodiment of a method and apparatus form making and using an IBAT system **10** in accordance with the invention, the base portion **14** and tower portion **16** may be formed with concrete construction techniques, laying in many yards, and thousands of pounds, of concrete.

This concrete may be reinforced by pre-stressed elements, such as pre-stressed cable (e.g., wire rope), rod, re-bar, and so forth. By whatever mechanism, the base (anchor) portion **14** and tower portion **16**, constituting the bulk of size and mass provide the tower and bollard functionality. They can be installed or constructed on site by many smaller loads of concrete transported poured on site.

Referring to FIGS. **5** and **6**, while continuing to refer generally to FIGS. **1** through **15**, in one embodiment of an IBAT system **10**, a width **44** of the base portion **14**, along with a length **46** thereof and thickness **47** may be engineered to eliminate much of the conventional geologic analysis and preparation that would have been required for conventional installations.

The width **44**, length **46**, and thickness **47** are selected and engineered in accord with principles of structural and materials engineering. They are calculated in combination with the height **48** at which the cable **18** or line **18** passes over the bollard **12**, as well as the height **49** of the tower portion **16**. Together, the total weight imposed on the supporting terrain **22** by the base **14** and tower **16** is selected to be secured by frictional forces between a level region formed in the terrain **22**, and the total weight of the integrated base **14** and tower **16**.

Frictional forces **50***f* are a function of normal forces **50***w* due to weight of the base **14** and tower **16**. Meanwhile, the load **50***t* or tension **50***t* applied by the lines **18** over the bollards **12** urges the IBAT system **10** to slide. Since frictional force **50***f* tending to restrain the IBAT system **10** against sliding acts in opposition to that tension force **50***t* or that resolved component thereof operating directly opposite to the frictional force **50***f*, the base portion **14** and tower portion **16** may simply be sized to meet the frictional requirements.

As an engineering principle, frictional coefficients are a property of two materials with contact force and friction therebetween. Necessarily, surface roughness, materials of which surfaces are formed, and the like all have an effect on the coefficient of friction. Nevertheless, the frictional force **50***f* at which any object will slide is equal to the frictional coefficient (μ), multiplied by the normal force **50***w* or weight **50***w*. Thus, the overall weight **50***w* may be engineered to overmatch the tension force **50***t* by a "factor-of-safety" multiple. Of course, any vertical component of tension forces is resolved against the weight **50***w* or support forces **50***s* of the earth supporting the IBAT system **10**.

In the illustrated embodiment, the support forces **50***s* are distributed along the lower surface **51** of the base portion **14**. Similarly, the overall weight **50***w* is distributed along the entire surface **51** of the base portion **14**. However, for analytical purposes, one may concentrate the total weight **50***w* at a center of gravity **43** spaced some distance **45** away from a leading edge **41** of the base portion **14**. That distance **45** is calculated to resist tipping about the leading edge **41**. Frictional forces **50***f* may be designed to simply reduce the need to excavate, analyze geological conditions, and the like. So long as the weight **50***w* across the surface area of the bottom surface **51** is supported and stable against settling, sliding, and tipping, there exists no need to anchor to bedrock. There is no need to form footings for a metal tower or other erected construction, or the like. Instead, the weight **50***w* assures a frictional force **50***f* sufficient to resist movement in response to the tension load **50***t*, and a rotational moment sufficient to preclude tipping.

This last consideration that the IBAT system **10** addresses is the direct result of a frontal load collinear with the horizontal component of the tension force **50***t*. For example, a vertical tower of conventional design benefits from a balance of forces between guy lines distinct from the tower structure itself. Struts, radio towers, meteorological towers, power line towers, and the like, extending hundreds of feet, benefit from a balance of forces guyed to the surrounding ground.

Similarly, large cranes extend for long distances, hundreds of feet. They are supported against bending not by their own mass or material, of the (typically) latticed structure. They are stabilized rather by the tensioning lines (guys) surrounding them. Any radio station having a broadcast tower will typically be found with a multiplicity of guy lines applying equal forces at selected locations and drawn to several surrounding and symmetric pull points on the ground. Thus, column buckling is averted by the lateral (cross ways) stabilization the guy lines provide for the main structure. Thus, the structure itself need only support the longitudinal load therethrough, with no lateral loading orthogonal thereto.

In contrast, the IBAT system **10** in accordance with the invention dispenses with the concept of guy lines and separate anchors. It does not seek to guy a tower against the load presented by the tension force **50***t* presented by the lines **18**. Instead, the bollard **12** directly supports the tension force **50***t*. The bollard **12** serves to reduce and equalize tensile (tension) forces among all the strands of the wire rope **18** that serves as a line **18**. The diameter of the bollard **12** is engineered to reduce to a safe and effective value the turn (bending) radius of the line **18**. It also applies friction to the line **18** resisting sliding therebetween.

Meanwhile, loading is transferred from the bollard **12** into the tower **16**. The tower **16** is simply a reinforced slab **16** or fin **16** of concrete in certain embodiments. Reinforcement and material connections between the tower **16** and the base portion **14** apply the weight of the base **14** (anchor **14**) aggregated with the weight of the tower **16** to a total weight **50***w*. That weight **50***w* may be analyzed as operating through a center of gravity **43** to weigh down the bollard **12**, and fix it against sliding, lifting, turning, pivoting (yaw), tipping (pitching), or other movement by application of a suitable weight **50***w* and frictional, resistance force **50***f*.

One aspect of the overall length **46** of the base portion **14** that also must be considered is the position of the center of gravity **43** at a distance **45** away from the front edge **41** or leading edge **41** of the base **14**. Theoretically, if the weight **50***w* and the center of gravity **43** could be at an improper combination. Then the tension force **50***t* and the friction force **50***f* may introduce a couple (as that term is used in structural engineering). That couple would tend to rotate (pitch) the overall IBAT system **10** in a clockwise direction in the image of FIG. **5**. However, sufficient length **46** engineered in the base portion **14**, along with distributed weight engineered in the concrete, and reinforcement engineered throughout and between the tower **16** and the base (anchor) portion **14**, will yield a distance **45** by which the center of gravity **43** is displaced away from the leading edge **41** of the base **14**, thus resisting tipping. The anchor **14** literally anchors the bollard **12** and line **18** to the earth by weight **50***w* and friction **50***f* alone, with no need for any penetration into bedrock or even into surface soil or above other overburden bedrock.

The comparatively low profile on the order of from about 12 to about 20 feet of the IBAT system **10** needs merely an excavation to create a flat region on the brow of any hill. Any level place formed stably along a descent on a mountainside may be completely sufficient to support the system **10**. Thus, the need to clear large swaths of vegetation or extend high above it, the need to employ cranes or helicopters to haul and install tall metal structures as towers, and the like have been eliminated. The overall height **48** of the matched cables **18** running over the paired bollards **12** along with the length **46**, may be engineered along with the overall weight **50***w* to resist sliding (translation), tipping (pitch), turning (yaw), leaning or canting (roll), and thereby fully stabilize the lines **18**.

Referring to FIGS. **7** and **8**, while continuing to refer generally to FIGS. **1** through **15**, the lower end of a ride **20** may operate in similar fashion to the upper end. Typically, the loading may be reduced, inasmuch as the integrated system **10** at the bottom of a ride **20** is below the main span and weight of lines **18**, whereas the system **10** at the upper end of the ride **20** is above the cable **18**. Nevertheless, the cable tension **50***t* still results at both sides from the suspension between the bollards **12** above and below.

In one embodiment, a base (anchor) portion **14**, tower portion **16**, and bollard **12** may stand off some distance **52** away from a landing location on a platform **28**. Typically, a platform **28** is used in constructing or otherwise designating a landing station **31**. It provides a consistent distance between a user and a landing platform **28**. Dirt, grass, natural surroundings, and the like are subject to the vagaries of weather, especially rain, consequent mud, and so forth. Also, dirt tends to dig out and displace as a result of dust, mud, wear, and so forth. Thus, the terrain **22** may typically be covered with a platform **28** or deck **28**, establishes an elevation and a longitudinal location along the line **18**, which serve to fix a landing location for a user.

A braking system as described in the other references incorporated herein by reference will provide a more comfortable stopping process rather than an abrupt halt, recoil, or the like. In fact, certain embodiments of attenuation systems described in the aforementioned patent documents incorporated hereinabove by reference disclose methods of tailoring the impact forces transferred into a trolley **40** in the braking distance **52**, as well as attenuating any recoil (e.g., bounce back, oscillation, etc.), or the like.

In the illustrated embodiment, the trolley **40** may be captured by a receiver **54** or acceptor **54** interfacing with a resistance (e.g., spring) mechanism **56**. Again, the patent documents incorporated hereinabove by reference disclose multiple mechanisms for providing resistance systems **56** or resistance mechanisms **56**, as well as mechanisms for receiving and securing a trolley **40** into a receiver **54**, attenuating recoil (e.g., rebound, oscillation, etc.), and otherwise bringing a rapid yet comparatively soft braking force to the trolley **40** and its suspended rider.

Referring to FIGS. **9** through **11**, while continuing to refer generally to FIGS. **1** through **15**, certain details of the bollard **12** are illustrated. In the illustrated embodiments, a bollard **12** may sit near a corner **58** as a registration position near a top of a face **62** or surface **62** forming the vertical plane at the exterior of a tower portion **16**. In the illustrated embodiment, a flange **60** forming a base **60** or mounting ring **60** is typically an integral portion of the bollard **12**. In one embodiment, the flange **60** fits against a face **62** or against a gasket on the surface **62** of the tower portion **16** just below the top edge **58** thereof. Also, an inner flange **64***a* and an outer flange **64***b* operate as capture flanges **64** to constrain the line **18** wrapped around the bollard **12**. The bollard may, in the alternative be cast as a reinforced extension from the tower **16**.

The line **18** may be initially laid against the inner flange **64***a* during installation. Meanwhile, several wraps of the line **18** (e.g., from 8 to 10 typically) around the bollard **12** distribute force, increase frictional load, reduce tensile stress in the line **18**, and otherwise distribute the load. The bollard **12** does not wear any particular location on the line **18** much more than another, permits a certain amount of slipping, tightening, and so forth, that otherwise distributes the forces along a bend diameter specified by the manufacturer of the line **18**.

For example, the smaller the diameter of a turn (bend) to which the line **18** is exposed, the greater disparity between the tensile force in the outermost fiber (maximum diameter) and innermost fiber (minimum diameter) of the curvature. As in all bending, the innermost surface or innermost fiber in such a turn of the line **18** may actually be in compression. Thus, the tensile forces **50***t* added to the disproportionate loading due to a "tighter" bend in the line **18** may add up to overstressing and thereby damaging the line **18**. A manufacturer can specify for any cable **18** or line **18**, a particular working load and (force or stress in force per unit area) and bend diameter about which it may be turned or wrapped. This is based on material properties, dimensions, and distortions tolerable while still maintaining its load rating (maximum permissible working force).

In the illustrated embodiments, the flange **60** is secured against the surface **62** of the tower **16** by bolts **66**, and nuts **68**. Various fastening mechanisms **66** may be used, but bolts **66** anchored within the tower **16** have been shown to be effective, and meet construction standards for engineered structures.

From the flange **60** the actual barrel **70** or core **70** that constitutes the shaft **70** or tube **70** about which the line **18** is wrapped extends away, typically at a constant diameter. The diameter may vary. However, it has not been found cost effective to vary the diameter of the drum **70** or barrel **70** of the bollard **12**.

An ear **72** may extend from the inner flange **64***a*. One or more ears **72** may be provided with apertures **74** in order that the clevis and pin attachment on a hydraulic cylinder may be secured thereto. When a cable is pulled, and properly tensioned, it is possible in an apparatus and method in accordance with the invention to draw a line **18** to a predetermined tension, or position.

First securing a hydraulic cylinder by a pin through the aperture **74** in the ear **72** and then clamping the opposite end of the extended hydraulic cylinder to the line **18**, the line **18** will pull toward the bollard upon closure of the length of the hydraulic cylinder. Thus, the line **18** may be wrapped around the barrel **70** of the bollard **12** without the loads of the tensile force **50***t* therein. That is, the tensile force **50***t* is supported directly by the flange **64***a* and the ear **72** thereon supporting one end of the hydraulic cylinder clamped to the line **18**. Thus, operating the hydraulic cylinder, closing it to a shorter length, applies tensile forces to the line **18**, bringing it into position.

The presence of two ears **72** and two apertures **74** permits the use of multiple cylinders, in order that tensioning of the line **18** may progress by stages. As one cylinder connected to one aperture **74** of one ear **72** comes closed, another cylinder may be attached to the other ear **72** at full extension length of the second hydraulic cylinder. Clamping effected by this second cylinder against the line **18**, permits subsequent closure. Taking the tension off the first cylinder, enables its removal (unclamping) for re-extension and re-clamping after the second cylinder has closed up all or part of its length between the fully opened and fully closed positions. The two cylinders may trade off until proper length, position, elevation, clearance, and tension are achieved in the line **18**.

In certain embodiments, the outer flange **64***b* may be provided with a corner **76** or extension **76** outside the radius of the circular portion of the flange **64***b*. For example, in the illustrated embodiment, the corner **76** is provided with a stop **78**. The stop **78** serves the purpose of registering a clamp **80** securing the line **18** around the barrel **70** of the bollard **12**. Once the length or span of a line **18** extending between an upper and lower bollards **12** has been established, each remaining extremity, tail, or end of the line **18** may be wrapped around the barrel **70** of the respective bollard **12**, and clamped off or tied off by the clamp **80** registering against the stop **78** on the corner **76**.

Referring to FIG. **11**, while continuing to refer generally to FIGS. **1** through **15**, certain structural reinforcement embeds opposite a bollard **12** through the face **62** of the tower portion **16**. Actually, multiple embodiments illustrated rely on different mechanisms by which the fasteners **66** or anchoring bolts **66** may be secured within the wall **16** or fin **16** that is the tower **16** or tower portion **16** of an IBAT system **10**.

Also of note, the barrel **70** may be selected to have a length, outer diameter, inner diameter, and material constitution engineered to support the tensile load **50***t* that will be applied thereto. To that end, in the interest of economy and safety, the section modulus of the bollard **12** may be increased by adding reinforcements **71** or gussets **71**. Alternatively, the wall thickness of the barrel **70** may be increased. However, it has been demonstrated that greater stiffness with less material is provided when materials are shaped to put more material away from the "neutral axis" of a structural section and near an outermost fiber, not necessarily an equal cross section at all distances of material.

The principle of "section modulus" as used here is well understood and documented in many engineering textbooks. Section modulus is a characteristic of various shapes of mechanical structures, and demonstrates that stiffness is proportional to the base distance multiplied by a constant times the third power of the distance from the neutral axis (usually near the center of mass of the section).

Typically, the flanges **60**, **64***a*, **64***b* may be welded onto the barrel **70** of the bollard **12**. Casting, forging, threading other assembly techniques, and the like may also serve. However, a welded construction has been found suitable. However, it has been found more convenient to bolt the flange **60** against the surface **62** of the tower **16**, after concrete pouring and setting up have occurred.

However, there are several mechanisms available for stably securing the flange **60**, and thus the bollard **12**, against the surface **62** of the tower portion **16**. Several concepts are illustrated here. Typically, a pattern of bolts **66** may be formed and positioned to extend through the face **62**. Each of these bolts **66** may penetrate some distance into the tower portion **16**, or all the way through. In fact, the two bollards **12** may be preassembled or assembled on site and placed to penetrate through the forms into which the tower **16** is poured. Thus, each of the bolts **66** may represent a shaft **66** passing all the way through the tower portion **16**.

One will note in the cutaway portion of the tower **16** various embodiments of reinforcement bar **82** or rebar **82**. The vertical rebar **82***a* will typically be wired to horizontal rebar **82***b*. Again, note herein that any use of a reference numeral alone indicates any or every item of that name, type, or class. The same reference numeral followed by a trailing letter indicates a specific instance of that general item. Thus, it is proper to speak of all bolts **66**, and of specific bolts **66***a*, **66***b*, **66***c*, **66***d*, **66***e*, and so forth.

Likewise, the rebar **82** may have specific orientations including the vertical **82***a*, the horizontal **82***b*, and others. Wire **84** is typically used for ties **84** to hold rebar **82** in place. Later on, concrete has been poured around the rebar **82**, so the individual pieces thereof become rigidly fixed due to their relative positions, the rigidity of the surrounding concrete, and the texture **83** on the surface thereon. These features keep the rebar **82** in place, and fixed with respect to bolts **66** and other pieces of rebar **82**. Thus, the wire **84** or ties **84** need not be particularly strong, only sufficiently strong to keep each of the lengths of rebar **82** in place until after the concrete has set.

In the illustrated embodiment, bolts **66** of various embodiments may be used alone, together, mixed, or exclusively of one type. For example, the bolts **66***a*, **66***b* are represented as through-bolts **66***a*, **66***b*. These are threaded at both ends, and proceed all the way through the thickness dimension of the tower member **16** or tower portion **16**. In contrast, the bolt **66***c* is illustrated with a bolt head **86**. That bolt head **86** would be anchored inside the concrete, and thus stabilize the bolt **66***c* in the longitudinal direction against motion. In contrast, the bolts **66***a*, **66***b* may be stabilized somewhat by friction, but will ultimately be stabilized in position by the presence of the nuts **68** on each end thereof, securing the flanges **60** of the respective bollards **12**.

Likewise in contrast, the bolt **66***d* has a return **88** or foot **88** at one end. This tends to stabilize the bolt **66***d* in rotation or a circumferential direction about the bolts main longitudinal axis when a nut **68** is being threaded thereon, as well as in a vertical and horizontal direction. That is, in the vertical direction, and in both transverse and lateral horizontal directions (e.g., parallel and perpendicular, respectively, to the surface **62**), or in both the full vertical planes and the full horizontal plane, the foot **88** provides stabilization of the bolt **66***d*.

Likewise, the ties **84** may be applied to secure the bolts **66** to the rebar or with the rebar **82**. In other embodiments, the bolts **66** may be arranged in a pattern, fixed to some type of a base, and that entire base may be poured around by the concrete. Meanwhile, that base, having registered therein the alignment of each bolt **66** parallel with the others thereof, as well as registering in various other dimensions, by the location of the base, may be secured to the rebar **82** to provide a much easier installation of the flange **60** thereon.

In one alternative embodiment, the bolt **66***e* illustrates texturing **90** or threads **90** tending to stabilize the bolts **66***e* against rotation, as well as longitudinal movement. Thus, the presence of the concrete within the texture **90** tends to secure the bolt **66***e*. In other embodiments, inserts may be provided between the faces **62** of the tower portion **16** to form passages through subsequently poured concrete, through which bolts **66** may be passed to secure to the flanges **60**.

Referring to FIG. **12**, while continuing to refer generally to FIGS. **1** through **15**, in one embodiment of a process for engineering and installing IBAT systems **10** a series of topographical maps **92** may be prepared representing paths or spans across various terrain **22** over which the ride **20** will operate. Various features may be seen in plan view as illustrated in the maps **92***a*, **92***b*, and **92***c*, **92***d*. One will note that each of the maps **92** represents an area where an IBAT system **10** will be installed.

In the illustrated embodiment, two IBAT systems **10** will often be installed in the area of each of the maps **92**. For example, a span **94** will have an upper terminus **92** and a lower terminus **98**. At each terminus, an IBAT system **10** is located. Thus, FIG. **12** represents a "canopy tour" in which various spans **94** may be traversed between adjacent terminals **96**, **98** or terminae **96**, **98**.

Referring to FIGS. **12** through **13**, while continuing to refer generally to FIGS. **1** through **15**, the clearance between the line **18** above a rider and the terrain **22** below a rider may be engineered by investigating various locations along the topography of FIG. **12** that will provide clear spans **94** without an obstruction. For example, the ups and downs in features of the terrain **22** may cause a cable line **18** or track line **18** to come too close to underlying terrain **22**.

For example, in FIG. **13**, one chart **100** prepared for data associated with a particular span **94** showed that the distance access **101** along the span **94**, when plotted against the elevation axis **102** provided three profiles. The profiles included the terrain profile **104** and the rider path **106** or rider profile **106**, representing the lowest point on the rider, the feet. Likewise, the line profile **108** represented the line **18** in space as tensioned.

One will notice in the particular embodiment that near the upper end or the higher elevation **102**, the rider is sufficiently close to the terrain **22**, that it would be advisable to fence off a region so that a standing passerby does not wander under a user, whose feet or harness may strike the standing person below. Meanwhile, near the center of the curves **104**, **106**, **108** a tremendous difference in elevation **102** exists between the terrain **22** and the curve **108** representing the line **18**, and the curve **106** representing the lowest point of a user. One will note, however, that a brow of the terrain **22** then again projects out and approaches closer to the curves **106**, **108**, although never as close as illustrated in the upper reaches thereof.

In order to complete an installation, and engineer its location before installation, the topography of FIG. **12**, as well as the elevation clearances of FIG. **13** need to be calculated. Safety factors should be introduced for protection of persons and equipment. However, one benefit available by the use of IBAT systems **10** is the ability of the towers **16** to position the top of the bollards **12** at a mere 12 to 20 foot distance above the installation grade elevation **26** of an IBAT system **10**.

Referring to FIGS. **14** and **15**, while continuing to refer generally to FIGS. **1** through **15**, a practice unit **110** may be installed on a pad **111** constituted by concrete, wood, bedrock, native earth, or other fixturing. Bollards **112** may be placed at opposite ends of lines **18**. A simple support structure **114** may be installed in order to provide some desired amount of height differential between the elevation **116*a*** or height **116*a*** at the upper end or upper bollard **112*a***, and the height **116*b*** at the lower bollard **112*b***.

The distance **118** between the bollards **112** may be nominal, compared to a typical cable ride **20**. For example, a distance of from about 50 to about 100 feet has been found entirely suitable. In fact, a target distance of about 75 feet including between about 10 and 20 feet of a braking mechanism **56** has been found entirely suitable.

One purpose of the practice unit **110** is to permit people on a comparatively short (tens not thousands of feet) and comparatively low (feet or yards, not hundreds of feet above earth), and thus in a comparatively safe environment to practice attaching and disattaching the trolley **40**. A trolley connects to a harness of a rider. It must be safely secured. Users practice attaching and disattaching the trolley **40** to and from the line **18**.

Again, in the patent references incorporated hereinabove by reference, numerous details of trolley design, including interlocks, safety mechanisms, bails, plates, locks, and the like have been illustrated. Some are best adapted to more-or-less permanent attachment. That is, they do not remove readily for each ride. Others may be quickly, in a matter of seconds, secured and locked, or unlocked and removed from a line **18**.

A practice area **110** assures that the differences in elevation **102** between the curves **104**, **106** would not become the test of skill of a user. In the illustrated embodiment, the distance **118** may be set at about a target value of about 75 feet. This provides the experience, easy walk back distances **118** after each ride, and a suitable test, without any particular high level of risk.

Benefits accruing to an IBAT **10** in accordance with the invention are plentiful. An IBAT **10** is distinct from conventional systems for anchoring track lines and other lines for trams, lifts, ziplines, canopy tours, ski lifts, and so forth.

For example, the base **14** or anchor portion **14** serves as a longitudinal datum anchoring, tensioning, and supporting the line **18**. It also provides vertical support for the tower portion **16** and the bollard **12** secured thereto. Also, the base portion **14** or anchor **14** spreads as a footing across a sufficiently large area that no other footings, guys, or pilings are required. Rather, the anchor **14** serves as a pad that has been poured and reinforced such that it needs no underlying footings, only its native, undisturbed, underlying ground. This has implications for limiting the geological analysis, testing, and preparation required.

Reduced soil testing and analysis are required. As a practical matter, only the loading requirement and the ability of the underlying soil to support load that impose any significant requirement on the soil conditions under the anchor **14**. Likewise, there is reduced geological interface, preparation, and so forth. Soils need not be disturbed.

Drilling is not required. Excavation is not required other than sufficient to provide a flat surface. The remaining geological material under the anchor **14** is undisturbed, and thus compacted, well settled, and stable. There is no need to dig to bedrock.

By the same token, there is no requirement to anchor into bedrock, drill, excavate to bedrock, or dig down to engage the bedrock with buried pilings or other structures. Thus, there is no need to maintain, inspect, replace, and otherwise monitor and maintain any buried structures. Similarly, there is no need to anchor into bedrock with some base length of lever arm or guy line in order to prevent tipping. Guy lines are no longer required in a system **10** in accordance with the invention.

Instead, the anchor **14** operates on the basis that the frictional force is equal to the coefficient of friction multiplied by the normal force (weight **53**) of the system **10**. Of course, the overall weight **53** will include the benefit of the tower portion **16** as well. Accordingly, a bed of crushed rock will provide suitable engagement of the anchor portion **14** with the soil, and thus provide a coefficient of friction suitable to resist lateral or longitudinal forces (with respect to the line **18**) in any horizontal direction.

Since no footings are required underneath, less excavation, results, because depth is effectively an irrelevant parameter. This will almost always simplify construction. An anchor **14** in accordance with the invention will fit on any brow of a hill, with a simple crushed rock interface. Moreover, reduced preparation of the surface, because the surface is left undisturbed, need only involve sufficient excavation to form a flat region. Moreover, an artificial "brow" of any hill may be created by a simple excavation into the side of the hill. Thus, an anchor **14** or base portion

14 in accordance with the invention may be located at virtually any suitable location position on a hillside or mountainside.

Suitable engineering is required for the dimensions of length of the anchor **14** in the longitudinal direction of the cable **18**, width in a lateral direction orthogonal to the horizontal vector or direction of the cable **18**, and a vertical direction. Thereby, the size, weight **50***w*, or **53**, and leverages may resolve all tipping forces or tipping moments created by the tension of the line **18** pulling against the bollards **12** on the tower portion **16**. Moreover, the frictional forces **50***f* as discussed hereinabove resolve any sliding forces **50** due to the tension applied by the line **18** against the bollard **12** and anchor **14**. All are ultimately resolved through the tower **16** and anchor **14** against the ground.

Another benefit is the monolithic structure of the entire IBAT system **10**. The anchor portion **14** may be poured with and reinforced with the tower portion **16**. The bollard **12** may either be cast or fastened to the tower portion **16**. Thus, a monolithic IBAT system **10** provides a smaller footprint of affected ground area, reduced height, positioning at a location along a mountain, and particularly any brow presenting itself, or the like. Even when the brow or flat on the side of a mountain is created by excavation, the underlying soils are undisturbed, and have often been so for centuries if not millennia. A simple crushed rock surface treatment will prepare the flat region of the underlying soil to receive the poured anchor **14** or base portion **14**.

The reduction of overall footprint by the anchor **14** itself, as well as any supporting and surrounding accessories assures low environmental impact. Appearance, color, shape, and so forth are easily obscured within the nap of the earth, and particularly matched within surrounding foliage. A large metallic structure extending above foliage is no longer necessary. In most embodiments, the IBAT system **10** at the top of a line **18**, and the IBAT **10** at the bottom of the line **18** may be virtually identical. Thus, comparatively low profile, with no need to dig significantly lower into the surface of the soil provides low impact, low profile, low visibility, and so forth. In most embodiments, additional digging does not improve loading, compaction, or the tower positioning.

Since the anchor portion **14** is often placed on already stable, centuries-settled, compacted ground, no forces of settling, tipping, sliding, or the like are sufficient to move it. Typically, the vertical thickness of the anchor portion **14** may be from about three to about eight feet. It has been found that a target thickness of about five feet on approximately a 21 foot square (plan view) provides a suitable anchor portion **14**. This may use from about 40 to about 100 yards of concrete. Typically, the anchor portion **14** with proper dimensioning requires about 75 yards of concrete.

The tower **16** may extend from about 8 to about 16 feet above the upper surface of the anchor portion **14**. This will depend on the installation. However, it only represents from about 20 to about 50 yards of additional concrete. The thickness of the tower **16** may be from about three to about six feet, and is typically on the order of about four to five feet. A target value of about four and a half feet has been found suitable with a volume of about 24 cubic yards of concrete. Meanwhile, a height of about eight feet, placing the top of the bollard **12** at about seven feet above the anchor portion **14** has been found a suitable target distance.

Meanwhile the tower **16** serves as a vertical datum. As a monolith with the anchor portion **14**, the tower portion **16** provides symmetric loading with no need for guys, also called guy lines. At such a reduced height of the tower **16**, stability is not a problem against tipping. The length of the anchor **14** and tower **16** may simply be calculated along with their thicknesses and heights to provide sufficient mass to reduce the moment that the lines **18** can apply thereto. In other words, the mass and weight along with the dimensions of the anchor **14** and tower **16** as well as the positioning of the bollard **12** control the resistant to tipping and thus prevent tipping of the IBAT system **10** by the line **18**.

No conventional 40-foot tower is required, no wide-area guy lines, reduced environmental impact, shorter distances of affected areas, and so forth all benefit the environmental acceptability of a tower **16** in accordance with the invention. The installation footprint is much less than a conventional installation, and a loading deck **28** need not be towered.

That is, the loading deck **28** need not be positioned on top of the tower **16** as in conventional installations. Instead, the loading deck **28** may have a very low environmental impact, a low profile, may be substantially identical at upper and lower ends, and may be substantially at ground level. Clearances for foliage, safety, and so forth can be accommodated within the dimensions discussed hereinabove. Thus, the shape, size, height, length, and so forth required to position the bollard **12** at its optimal location, provide for a weight and tipping moment of the IBAT **10**.

It **10** will conveniently remain fixed to support the lines **18** on the bollards **12**. Meanwhile, during construction, no transport of a 40-foot tower by helicopter or other mechanical means construction and lifting to an elevation 3,000 feet above a base, or the like, is required. The expense of the tower structure and its high cost installation are eliminated.

The braking section is typically on the order of from about 40 to about 100 feet, with a target value of about 65 feet. The braking region may be less, but a 65-foot target for the length of a braking section above the lower IBAT system **10** has been found suitable.

Meanwhile, the extension of from about eight to about sixteen feet, placing the bollard **12** or the top of the bollard **12** at about seven feet to about fifteen feet above the anchor **14** has been found suitable. Foliage may be trimmed to some minimal extent in order to reduce the need to completely remove foliage along the ride path. Alternatively, from the brow of a hill, proper placement of the anchor **14** and tower **16** require minimal impact on foliage to provide a clear path for a rider suspended on the line **18**.

The bollard **12** may be configured in an arbitrary diameter according to the size of the line **18** and the requirements the manufacturer thereof puts on the bend radius thereof. The bollard **12** may be fastened to an embedded rack of bolts **66**, or through-bolts **66**, which may be cast into the tower **16**. Bolts **66** may be connected or positioned such that they obtain the benefit of the reinforcement **82** or rebar **82** embedded within the tower **16**.

In certain embodiments, the bollards **12** may be wrapped with line **18** that is not under tension. For example, as described hereinabove, the line **18** may be drawn by a hydraulic cylinder, providing non-tensioned, unstressed, end portion of the line **18** to be wrapped around the bollard **12**. It is clamped securely to be held by the stop **78** on the corner **76** of the bollard **12**.

By having identical bollards **12** on opposing sides of the tower **16**, the balanced forces resulting will eliminate any tendency to yaw. Meanwhile, the frictional forces are also calculated to resist such movement.

The bollards **12** may actually occupy any arbitrary positioning in space about the tower **16** that may be desired. Thus, toward a position near the front of the tower **16** may provide more clearance for a rider, but near the back of the tower **16** may also be selected as a location of the bollard **12**. However, the proportions illustrated hereinabove have been found suitable and within the engineering calculations required for mechanical stability.

Meanwhile, construction of the bollards **12** and installation thereof as described hereinabove result in an elimination of the cost of manufactured installation of a distinct bollard system according to the prior art. Again, no separate geological analysis, and indeed a reduced geological analysis corresponding to the anchor **14** is all that is required to support the bollard **12**. The strength and forces of the bollard **12** need only be matched to the line **18**, and supported by the tower **16**. No separate, independent bollard system must be created, located, and prepared for with its own geological analysis.

The bolts **66** may actually be doubly safe if manufactured as through-bolts. They could thereby not be worked loose or moved inasmuch as they would be part and parcel of the tower **16**, and secured with the rebar **82** therewithin. Nevertheless, anchored by any of the mechanisms discussed hereinabove, the bolts **66** may be aligned and secured within the tower **16**. They may or may not be directly anchored directly to the reinforcing bar **82**, inasmuch as they will be anchored to the reinforcing bar **82** by the intervening concrete of the tower **16**.

Typically, channel clamps **80** will be used to bolt the line **18** in fixed relation to the bollard **12**. That is, a clamp **80** secured by the stop **78** at a corner **76** of a bollard **12** provides a minimum stress, with no turn radius in the line **18**. Meanwhile, the symmetric loading of the paired bollards **12** on either face **62** of the tower **16** provides symmetric loading without guys. About seven passes or loops or turns of the line **18** are typically made around a bollard **12**. Clamping **80** is typically done at a force about double the load rating of the line **18**. A channel clamp **80** is typically preferred wherein two blocks provided with a channel in each are aligned and bolted together with the cable running down the channels in each. Thus, no kinking, bend radius, or the like is imposed on the length of the line **18** or cable **18** clamped thereby.

The loading platform **28** has additional benefits in that it may be low, virtually at ground level or within the nap of the earth. It can be placed below or above an upper or lower IBAT **10**, respectively, near a tower **16** clear of foliage, or adjacent the tower **16** directly. It may be positioned on stilts or other supporting structure in order to clear foliage below. Alternatively, it may benefit from the clearing of foliage nearby in order to provide a clear path for a rider to pass to or from the loading platform **28** or deck **28** along the path of the line **18**.

There is no need to "tower" the deck **28**, or place it on top of a tower **16**. Rather, it may be separate from a tower **16**. It is found along the path between the matched upper and lower towers **16** securing the opposing top and bottom ends of the line **18**. By having the loading deck **28** or landing deck **28** distinct from the tower **16**. Also, less structural requirement is made on the tower **16**, and less structural requirement is made on the deck **28** associated with a launch station **30** or landing station **31**.

Typically, a landing station **31** or a launch station **30** may be from about 15 to about 30 feet square or rectangular. With room for two lines **18** and riders and access by a worker from both sides, it should be at least 12 feet and preferably more than 15 to 18 feet across for maximum safety clearance. Typically, a target dimension of about 20 to 21 feet square has proven suitable. Typically, the level of the deck **28** is about eight and a half feet below the line **18** traveling thereabove. This provides clearance for a user, but access for a rider or attendant placing a trolley **40** on the line **18** or removing it therefrom.

Typically, a braking distance of about 65 feet between a loading or landing position on a deck **28** and the adjacent lower bollard **12** has been found suitable. A braking distance of from about 40 to about 100 feet is easily tractable. A target distance of about 65 feet has been found highly suitable, to provide a suitably soft landing, with an optimum rate of deceleration and attenuation of any rebound.

The present invention may be embodied in other specific forms without departing from its purposes, functions, structures, or operational characteristics. The described embodiments are to be considered in all respects only as illustrative, and not restrictive. The scope of the invention is, therefore, indicated by the appended claims, rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed and desired to be secured by United States Letters Patent is:

1. A tower system as an integrated, monolithic, multi-functional apparatus comprising:

a first base operating as an anchor having a mass and a surface area selected to render the first base effectively immovable, by reason of friction directly with respect to ground therebelow, the surface area being in contact with and on top of the ground;

a first tower, integral and substantially homogenously formed with the first base to be monolithic therewith, the first tower extending away from the base a distance vertically, defining thereby an operational height above the ground;

a first bollard, non-rotatable with respect to, and extending rigidly from the tower and shaped to reduce stress in a track line wrapped therearound and loaded in tension; and

the track line, wrapped around the bollard to extend away therefrom supporting a load in tension selected with the mass and surface area of the first base to support the load while maintaining the tower system substantially immovable.

2. The tower system of claim **1**, further comprising a trolley supported by the line to travel in at least one of the directions away from and toward the tower along the track line.

3. The tower system of claim **2**, further comprising a second tower substantially homogeneously formed with a second base and supporting a second bollard extending therefrom to support the track line wrapped therearound.

4. The tower system of claim **3**, wherein a material forming the first base and first tower is concrete.

5. The tower system of claim **4**, wherein the first base and first tower each further comprise steel in a reinforcing configuration within the concrete.

6. The tower system of claim **5**, wherein the first bollard is removably secured to the first tower.

7. The tower system of claim **6**, wherein the first bollard comprises at least one of concrete, steel, reinforced concrete, and a reinforced polymeric material.

8. The tower system of claim **7**, wherein the first bollard is formed of a material in common with the first tower.

9. The tower system of claim **1**, wherein the first base and first tower are each comprised principally of concrete and reinforced by steel extending contiguously therebetween.

10. The tower system of claim 9, wherein:

the tower system further comprises a first deck positioned lower than the first bollard, sized and spaced from the bollard and track line to receive and launch a rider from the first deck.

11. A tower system comprising:

a first base having a mass and a surface area selected to render the first base effectively immovable with respect to a supporting surface therebelow due to friction acting directly therebetween;

a first tower, integral with the first base to be monolithic therewith and extending away therefrom a distance vertically to define an operational height above the supporting surface;

a first bollard, extending rigidly, non-rotatably, and orthogonally from the first tower;

a track line, having a first end wrapped around the first bollard to be supported thereby and extending away therefrom; and

a trolley, riding on the track line to support a load by tensioning the track line.

12. The tower system of claim 11, wherein the base and tower are substantially homogeneously formed.

13. The tower system of claim 12, further comprising:

a second tower substantially homogeneously formed with a second base and supporting a second bollard extending orthogonally therefrom to support the track line having a second end wrapped therearound.

14. The tower system of claim 12, wherein a material forming the first base and first tower is concrete.

15. The tower system of claim 11, wherein;

the first base and first tower each further comprise reinforced concrete;

the tower system further comprises fasteners securing the first bollard to the first tower; and

the first bollard comprises at least one of concrete, steel, reinforced concrete, and a reinforced polymeric material.

16. The tower system of claim 11, wherein:

the first bollard is formed substantially homogeneously with the first tower;

the first base and first tower are each comprised principally of concrete and reinforced by steel extending contiguously therebetween.

17. The tower system of claim 11, wherein:

the tower system further comprises a first deck positioned at a distance below the first bollard, the distance being selected to space the deck from the first bollard and track line to receive thereon and launch therefrom a rider;

the tower system further comprises a second tower substantially homogeneously formed with a second base and supporting a second bollard extending orthogonally therefrom to support the track line, having a second end wrapped therearound.

18. A method comprising:

providing a tower system comprising

a first base having a mass and a surface area selected to render the first base effectively immovable with respect to a supporting surface therebelow due to friction acting directly therebetween,

a first tower, integral with the first base to be monolithic therewith and extending away therefrom a distance vertically to define an operational height above the supporting surface, and

a first bollard, extending rigidly, non-rotatably, and orthogonally from the first tower;

providing a track line, having a first end wrapped around the first bollard to be supported thereby and extending away therefrom;

providing a trolley, riding on the track line to support a load by tensioning the track line;

wherein the distance is selected, and the shape of the surface area is selected to prevent tipping of the tower and base in response to the tensioning; and

wherein the base and tower are substantially homogeneously formed.

19. The method of claim 18, further comprising:

providing a second tower substantially homogeneously formed with a second base and supporting a second bollard extending orthogonally therefrom to support the track line having a second end wrapped therearound.

20. The method of claim 18, wherein:

a material forming the first base and first tower is concrete;

the first base and first tower each further comprise steel reinforcing the concrete, the steel extending contiguously therebetween;

the tower system further comprises fasteners securing the first bollard to the first tower;

the first bollard comprises at least one of concrete, steel, reinforced concrete, and a reinforced polymeric material;

providing a first deck positioned at a distance below the first bollard, the distance being selected to space the deck from the first bollard and track line to receive thereon and launch therefrom a rider; and

loading a rider on the trolley at the deck;

releasing the trolley to traverse the track line extending as a catenary extending freely between the first bollard and second bollard; and

unloading the rider from the trolley proximate the second tower.

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